THE JOURNAL OF PROSTHETIC DENTISTRY

Vol. 7 JANUARY, 1957 No. 1

THROUGH THE EYES OF THE EDITOR

Thomas E. J. Shanahan tells of the founding and objectives of the Greater New York Academy of Prosthodontics. This is one of the youngest organizations in America which is devoted to the study of the problems of all phases of prosthodontics. Its Fellowship includes outstanding prosthodontic leaders and teachers of the Greater New York area. The contributions from this Academy will broaden and enhance the scientific coverage of prosthodontics by THE JOURNAL OF PROSTHETIC DENTISTRY. The Editor welcomes the Greater New York Academy of Prosthodontics and his new Associate Editor Thomas E. J. Shanahan.

John P. Frush and Roland D. Fisher discuss the effects of age on the appearance of teeth and their interpretation of these effects in the construction of dentures. It is obvious that changes in color, form, and position do occur with advancing age. The teeth of dentures should show the effects of aging that correspond with the effects of aging of other parts of the face. The failure to modify the teeth of dentures in such a way as to produce this harmony is probably one of the most common esthetic errors. It is not difficult to produce the effects of wear on teeth. The authors suggest the principles and methods to be used in producing the illusion of age of teeth in dentures. Their suggestions are worthy of routine application.

Samuel Friedman discusses the objectives of impressions, and describes his impression technique. His procedures are related to the anatomy of the tissues that surround and support the dentures. He makes use of white modeling plastic and indelible pencil marks to determine the form of the borders of his trays. This should be helpful, too, in the visualization of the borders, but the white impression material is more difficult to knife-trim than black. The acrylic resin trays may be warped by the action of the eugenol in the final impression material. Over all, the procedure is sound.

Robert B. Lytle discusses the management of abused oral tissues in complete denture service. The tests he describes show conclusively that the soft tissues of the mouth tend to adapt themselves to the impression surfaces of dentures, and that impressions of these tissues made immediately after ill-fitting dentures are removed cannot be accurate. He emphasizes the importance of making sure that the denture-supporting tissues are healthy and relaxed before impressions for new dentures are made. This is another indication that the construction of dentures requires more than mechanical skill. It requires a thorough understanding of and application of basic principles of physiology and anatomy.

Sydney S. Wagman describes his procedures for making immediate dentures. He recommends surgery to permit the reduction of a large horizontal overlap of anterior teeth, and the reduction of certain irregular anterior teeth. This may be open to serious question because the patient's appearance and facial expression will be changed in order to improve the appearance of the teeth, and because the patient would not have an opportunity to *see* the teeth in

their new positions *before* the dentures are inserted. The surgical technique he suggests seems somewhat radical since he removes the soft tissues from the area of the surgery. Further study of this procedure is indicated.

B. L. Faber describes his technique for making mandibular dentures with cast bases. He suggests that dentures with metal bases will come closer to meeting the objectives of complete denture service than will plastic bases. He recognizes the need for an exacting impression procedure on account of the difficulties in making adjustments on metal dentures. His dentures are a combination of plastic and metal which should meet his objectives. There is doubt, however, that *all* of the tendency of plastic to warp can be overcome by the metal.

J. D. Shriber discusses blood chemistry as a diagnostic aid in dentistry. He attributes some denture difficulties to an inadequate nutrition, and describes methods for making tests which are designed to indicate the adequacy or inadequacy of the nutrition. He gives what he considers to be optimum levels for the various tests. There can be little doubt that a definite relationship exists between the physical well-being of the patient and the success of their dentures. However, two dangers in this premise become apparent immediately. First, the danger of hiding technical ineptness behind an allegedly unfavorable condition of general health. Second, the danger of attempting the diagnosis and treatment of conditions which are not in the realm of dentistry. It would seem to be more practical to refer patients to physicians when imbalance of the blood chemistry is suspected. This is especially true where improper functioning of endocrine glands is involved. Endocrinologists tell us that treatment with various endocrine substances is a very critical matter because of the interlocking effect between these glands. The suggestions that are made should help to indicate when outside professional assistance is needed.

Raymond M. Contino and Harvey Stallard discuss various instruments which they use to study the relations of teeth to each other and to the anatomic structures with which they must be coordinated when in function. There can be little doubt that there must be harmony between occluding surfaces and inclines and the physiologic activities of the masticatory mechanism. This fact is more important than the method of achieving it, or the terminology used to express it. They use a graphic method for making the records and a hinge-bow rather than interocclusal records and the usual face-bow. The "jaw-writings" must be properly interpreted in order to be of value. The hinge-bow is admittedly more accurate than the arbitrary face-bow in *dentulous* situations. The interocclusal records are not as inaccurate as they would imply, because each one represents *one* specific jaw relation or position. At that given point an interocclusal record is as accurate an indication of jaw relations as any other method. The weakness of the interocclusal records is in the intermediate positions between any two interocclusal records. Therefore, the interocclusal records are *not all bad.* The authors use the term "articulation" in an all-inclusive sense. It includes the temporomandibular joints, the musculature, and all of the possible incline plane contacts of teeth while in function. It seems to be a little more difficult to visualize than does a separation of the various components of occlusion and a subsequent coordination of these components. These approaches to the problem might be compared to the analysis of a line. A line is a series of points related to each other in a definite manner. A series of interocclusal records or a series of "occlusions" in different jaw positions could produce the equivalent of "articulation" or of "jaw writings." Nevertheless, the important consideration is that their objectives appear to be the same as those of many others who express them in a different way. The detailed records and instruments they suggest will produce the results they set out to attain.

Joseph E. Ewing suggests a re-evaluation of the cantilever principle in fixed partial denture construction. He outlines the indications and contraindications for the use of this type of restoration. It is obvious that it can be used successfully in some situations provided certain principles for its use are adhered to. However, the cantilever bridge does not provide the maximum of function and its use is fraught with some hazards. It may develop an anterior loading of the mandible by placing the active functioning teeth in the front of the mouth. It is possible that

the temporomandibular joints would be damaged for some patients. He emphasizes the importance of balanced occlusion in these restorations, but apparently considers the balance of the teeth without correlating this factor of occlusion with the temporomandibular joints. No doubt there are places where this type of restoration can be used with good results provided the principles he specifies are followed, but its use should be approached with caution.

Charles B. Walton describes an instrument for paralleling preparations in abutment teeth, and discusses its use in different situations. The instrument is adjustable and should be useful.

Arthur S. Freese suggests the use of the new rubber impression materials for impressions to be used for making temporary acrylic resin crowns. The technique he describes appears to be practical and it has apparent advantages over some other methods.

Alver Selberg discusses the construction of full gold cast crowns and describes the techniques he uses for making these restorations. He points out the need for cure in diagnosis which is too often overlooked in routine practice. The suggestions made about fitting copper bands and the making of the impression in copper bands are particularly good. If the details of diagnosis and construction of full cast gold crowns are carefully followed, the resultant restorations cannot do other than prolong the life of the tooth and prevent further damage to the tooth by caries. The method of cementation will prevent errors in occlusion from developing at that stage of the work.

I. Gerson discusses the difficulties inherent in the cementation of full coverage restorations, and suggests a simple procedure for eliminating the entrapment of air and excess cement under the crown. The method is applicable only to crowns with acrylic resin facings.

T. J. Nidiffer and T. H. Shipmon urge dentists to use their specialized training and ability to care for patients who have surgical openings in the palate. They show that the techniques required for treating these patients are not appreciably different from those which dentists use routinely. The technique they describe is simple and practical. The service rendered to patients who are unfortunate enough to need this type of treatment is of great physiologic and psychologic value.

—Carl O. Boucher

THE GREATER NEW YORK ACADEMY OF PROSTHODONTICS

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THE GREATER NEW YORK ACADEMY of Prosthodontics was founded with the idea of bringing together a limited number of men, who are recognized in the field of prosthodontics and located in the New York area. Also, they must have manifested a willingness to contribute to the advancement of their specialty through research in the fields of gold and porcelain restorations, fixed and removable partial dentures, occlusal rehabilitation, the splinting of teeth, complete dentures, and related subjects.

The original organization committee consisted of thirteen men from the Metropolitan New York area, and they later became the charter members of the Academy.

The first meeting took place on Dec. 6, 1954, at the Finland House, New York City, and at that time it was decided that the first scientific session should include a paper from each of the original thirteen charter members, each featuring a phase of dentistry in which he was currently doing research.

The first scientific meeting was held just a year later, Dec. 3 and 4, 1955, at the New York University College of Dentistry. Essays and clinics were presented on gold and porcelain restorations, fixed and removable partial dentures, and complete dentures.

At the business meeting of this session, eighteen fellows were elected to Active Fellowship. Eight others to Associate Fellowship in accordance with the plans for assuring the Academy's future by encouraging qualified men to share in the work and future plans.

The informal but professional attitude of the Academy is best illustrated in its policy of calling a special meeting to hear a prominent visitor in the field of dentistry. Such an occasion was the meeting held for Dr. Ulf Posselt of Sweden during his stay in New York last March.

The members of The Greater New York Academy of Prosthodontics are appreciative of the fact that their Academy has been invited to become an affiliate of THE JOURNAL OF PROSTHETIC DENTISTRY, and thereby the privilege of submitting the results of their research for consideration by this outstanding publication has been extended to them.

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Received for publication July 14, 1956.

THE AGE FACTOR IN DENTOGENICS

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IN CONSIDERING THE MATTER of age interpretation in dentogenics,[1] we are dealing with the last of the three basic factors in this denture esthetic concept.

In our further investigation of this esthetic interpretation, we found it necessary to depart from the customary chronologic viewpoint of age, and to consider in coincidence the life span as a physiologic phenomenon. Birth, growth, maturity, decline, and death combine in that order to make up the physiologic life of the human being.

The dental history of the individual begins a few months after birth with the appearance of the first of the deciduous teeth. These are gradually replaced, beginning about the sixth year, and by the end of the twelfth year the eruption of all of the so-called permanent teeth, with the exception of the third molars, has generally taken place.

Even with the individual still in the early growing phase, it is often possible to detect a disparity between the two age interpretations. Dentally, this is frequently manifest by disease attacking the coronal portions of the teeth, and in many instances the ravages of caries have advanced until extraction of the teeth becomes necessary. Dr. Wilfred Terrell* relates his observations while in charge of the prosthetic department at the University of Malaya, stating that frequently children of 10 to 12 years required multiple extractions, and some 12 to 15 years old required complete dentures. This condition is also more prevalent in some parts of the United States than one would suspect.

The goal of the dentist is to help the patient to maintain a favorable relationship between his chronologic age and his physiologic mouth condition. It is possible for a great discrepancy to occur between these two early in life, but, of course, complete edentation is more frequently encountered with advancing age.

The objective of the age factor in dentogenics is to guide the prosthodontist in his efforts to maintain a high degree of conformity between his restoration and the patient's physiologic age structure.

THE IMPORTANCE OF THE AGE FACTOR

George Payne James has written in his book *Richelieu,* "Age is the most terrible misfortune that can happen to any man; other evils will mend, this is

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This is the fourth of a series of six articles on Dentogenics in the J. PROS. DEN. (5:586-595 [Sept.] 1955; 6:160-172 [March] 1956; 6:441-449 [July] 1956).

Received for publication Sept. 4, 1956.

*Personal communication.

every day getting worse." It is well for us to take this situation philosophically, however, for, though inevitable, at least we are not alone in it. Everyone keeps us company. The one thing which could add discouragement to this prospect would be to suffer premature aging. We have discerned that it is common for the mouth condition to age far in advance of the chronologic life of the individual, and thus contribute to a destruction of our dentogenic concept of the mouth as the center of the individual's objective personality.

Youth depends to a great extent for its projected charm upon the emphasized beauty of the mouth, including the teeth, as well as the eyes, hair, and skin. It must, for it has not had time to evolve other deeper qualities of more subtle nature.

There is beauty in advanced age as well as in youth. In light of our esthetic investigations, we feel this statement can be further elaborated to read, "Not only is there beauty in advanced age as well as in youth, but also there is an additional quality of dignity." Dignity can be attained only through the experiences supplied by time itself. The maintenance of this illusive quality of dignity must be the responsibility of the prosthodontist. It has been demonstrated to us many times that the absence of the age factor, together with its companion primary considerations of sex and personality in an artificial denture, destroys this objective dignity. In Fig. 1 will be seen the mouth of a young woman. The fresh youthful quality of skin texture, of lips, gums, and teeth is apparent here. It is quite obvious we are looking at a young feminine mouth. In Fig. 2, we note by contrast that age and dentistry have taken their normal toll of the originally more perfect tooth structure, gum health, lips, and skin texture. These are pictures of the mouths of a mother and daughter whose difference in age is about thirty years. The teeth of the young girl have a certain unmarred quality of youth. We have observed in the teeth of younger people, unless the incisal edge has been abraded, a bluish appearance of the incisal edge together with other colors less dominant. As the wear of age progresses, the bluish appearance of the incisal edge is abraded away. The aging process we see in the skin of the mother is also apparent in the teeth. Note that, in the two mouths, the arrangement and size of the teeth are almost identical, the main difference being the aging effects of time. It is apparent that the mother's aged teeth would not be acceptable in the young girl's mouth and, of course, the opposite would also be true.

MANAGEMENT OF THE AGE FACTOR

The variable degrees of the progress of age in the human individual are visibly noticeable. These qualities of age are just as apparent in the natural teeth as they are in the other living tissues. Early youth is apparent by the mamelon formations on the incisal edges of the permanent incisors. As youth is poetically expressed by the fresh crisp bloom on the skin, so does the young tooth convey the same brilliance of recent birth by the unabraded bluish incisal edge and unworn depth of the incisal enamel. As life progresses the adolescent quality of the tissues disappears, and simultaneously the complete coronal portion of the tooth comes into view, and the teeth have arrived at their terminal eruption position.

The mamelon is now entirely gone and the bluish incisal edge may be subjected to abrasion. Caries may now have attacked the anterior as well as the

posterior teeth, and the consequent discoloration as well as the variable coloring effects of filling materials have contributed their part in expressing the relentless effects of time.

Advancing age is, in spite of all efforts to avoid it, a seemingly irresistible force leaving in its pathway the undeniable symbol of its conquest—lines in the face, grayness or whiteness replacing the youthful hair color. Skin textures are not now as taut and smooth; time and the vicissitudes of life have effected their toll. Finally, the step becomes a little faltering, the shoulders a bit stooped, and the chronologic age line approaches its terminal.

Massler[2] states, "The oral tissues, like the tissues in other parts of the body, change markedly as the patient grows older. There is, of course, a wearing down of the teeth, the rate depending on the character of the occlusion, the muscular pattern and above all, the abrasiveness of the diet."

The physiologic age line pertaining to the natural teeth and their investing tissues could fail dismally to keep up with the rest of the body tissues, and the entire complement of teeth could be lost early in life.

How can we create the illusion of any desired age in the artificial substances which are at our command? This is the purpose of the age factor in the dentogenic concept, to develop the subtle interpretations which we feel have heretofore been almost completely ignored.

For simplification let us consider two parallel lines, first, the chronologic or life line, beginning with birth and extending to one hundred years; and, second, the mouth condition line of equal length upon each of which are points designating ten-year periods (Fig. 6). Let us presume that the natural teeth were intended to be retained through the prophetically promised life span of threescore years and ten, although, as we have noted, this is not a common occurrence. Then let us consider how frequently we find ourselves being called upon to construct complete dentures for individuals in their thirties, and some of younger age.

It might be said then that the prosthodontist is engaged, from an esthetic viewpoint, to help the patient maintain a favorable relationship between his chronologic life line and his physiologic mouth condition line. The artistic challenge is to create a desirable degree of realism in place of the all too common unthinking idealism we so often observe in dentures. Young[3] says, "It is less easy for dentists to accept the fact that denture patients desire a brand of denture esthetics closely paralleling the ideal esthetic values of the third decade of life." It has been our experience that the great majority of dentures are esthetically executed on this premise, and thus the individualistic age interpretation for each patient has become a lost art.

AGE IN THE ARTIFICIAL TOOTH

Every dentist who has undertaken to construct a set of dentures has been faced with the selection of an appropriate tooth shade for the patient. It is routine first to consider light shades for young people and darker shades for older ones, but this is not nearly sufficient to satisfy our dentogenic concept. However, so seldom do we see the tooth manufacturer making available to us a tooth possessing inherent characteristics expressing various degrees of age that it has been

necessary, in the past, for us to resort to the addition of porcelain stains in order to achieve a desired effect. How completely incompatible it is to replace the teeth of the person of 50 years or older with anterior teeth of uniform shade, unblemished mold form, and regularity of positions rarely found even in the teeth of a very young person.

Age as shown in Figs. 1 to 5 must be expressed not only by lighter or darker tooth shades, but as with increasing chronologic age, the skin assumes varied color effects, and the hair changes to gray, or white, so the teeth must reflect a variable color texture appropriately indicating the passing of time. A dominantly blue eye observed from a conversational distance will be found, on close color analysis, to possess a great variety of component colors to make up the pleasing effect of the whole. In our dental practices, we have the opportunity to observe nature's subtle use of many colors in the individual tooth in order to achieve an effective balance of esthetics. This is usually most pronounced in the teeth of those individuals of advanced age, and it presents us with one of our greatest problems today in our attempt to replace their lost teeth with a realistic effect.

Age in the artificial tooth must also be accompanied by mold refinement. The symbols of youth in the natural teeth are, aside from lightness of shade, the unblemished form of the newly erupted tooth. In its earliest appearance, the mamelon is present at the incisal edge of the central and lateral incisors. The cuspid presents a pointed tip which is very sharp in appearance.

The mamelon is soon abraded away, and the tooth assumes the youthful adult form evidenced by the enamel incisal edge of variable depth and of bluish hue. Later the sharp tip of the cuspid wears down to a more mature form.

As we advance along the chronologic life line of the individual, normal wear, plus trauma, and, in some instances, malocclusion, and disease make inroads upon the original purity of tooth form. The tooth ages with the individual, and, very often, the mouth condition gets far ahead of the chronologic life line. In the artificial tooth, then, we may reflect the appropriate age effects by such means as grinding the incisal edges and removing the incisal enamel at such an inclination and to such depth as to convey reality to the composition. The sharp tip of the cuspid suggests youth, and, as age increases, it should be judiciously shaped, not abruptly horizontally flattened, but artistically ground so as to imply abrasion against opposing teeth (Fig. 7). In advanced age, the bicuspids should be "softened" on the tips of the cusps to avoid the appearance of recently erupted teeth.

In the natural teeth, we have seen the effects of erosion high on the gingival third and the necks of teeth. Sometimes it is very advanced, at other times it is of a lesser degree. This erosion imparted to the artificial tooth, by careful grinding and polishing very effectively, conveys the illusion of vigor and advanced age. This can be accomplished by grinding and then repolishing the ground surfaces. Variable shading effects will be produced, as the ground surfaces will reflect light at a different angle from the unground portion of the tooth. Characterization, such as may be produced in this manner, opens up an entirely new field of artistry to the observing dentist, and an opportunity to rehabilitate the mouth of the edentulous person in such a realistic manner as to maintain true identity between the dental restoration and the sex, personality, and age of the patient.

FIG. 1 The Fresh youthful quality of skin texture, of lips, gum, and teeth is apparent in this illustration. The presence of the translucent incisal edges of the incisors and the tips on the canines is indicative of youth. Despite the largeness of the central incisors, natures skillful positioning of the laterals and cuspids keeps the mouth soft and feminine.

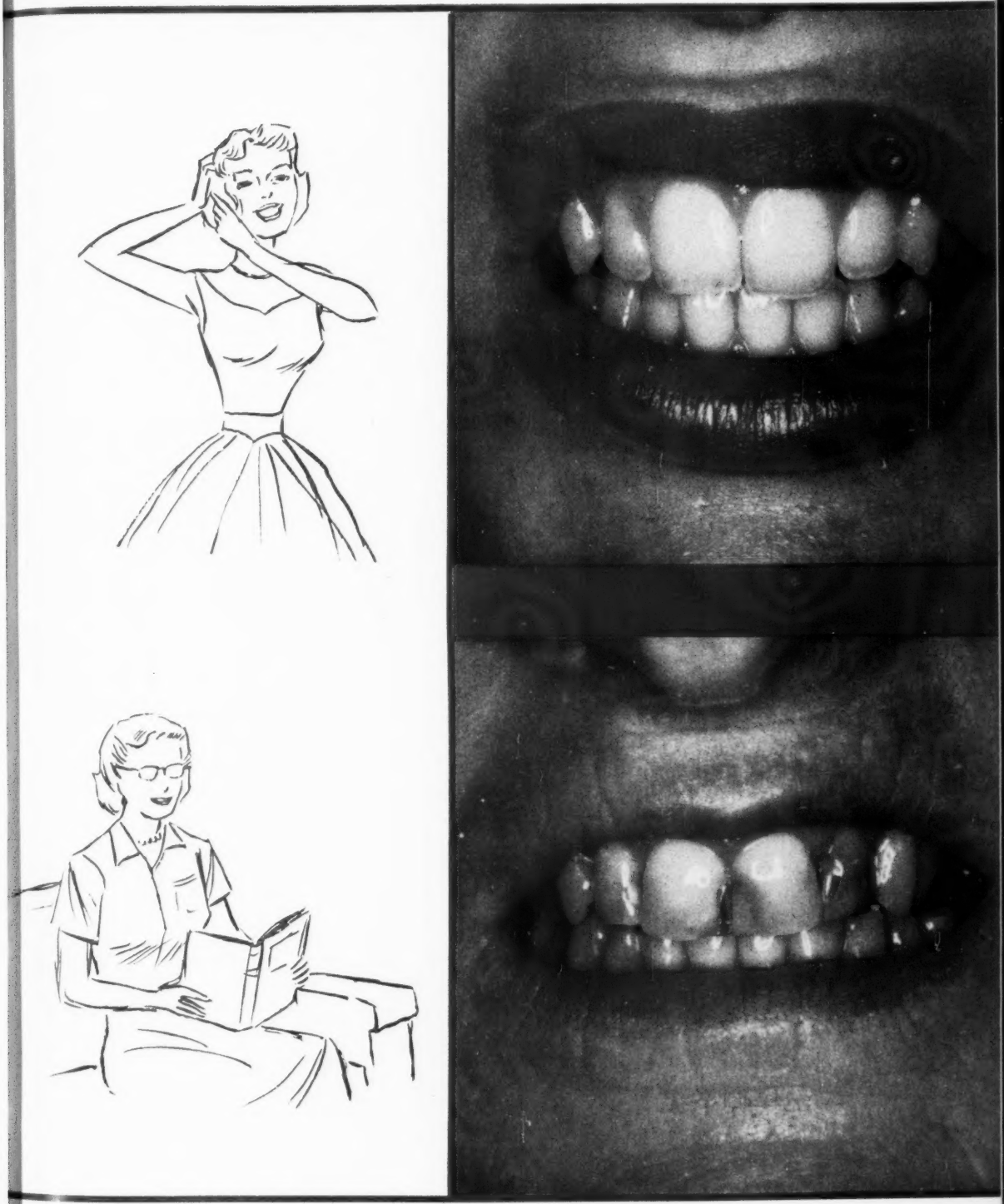


FIG. 2 The mother's mouth pictured here is thirty years older than the daughter's above, and the effects of time and dentistry are plainly in evidence. The size and positioning of the teeth are similar in both pictures, but the incisal enamel is abraded away by age.

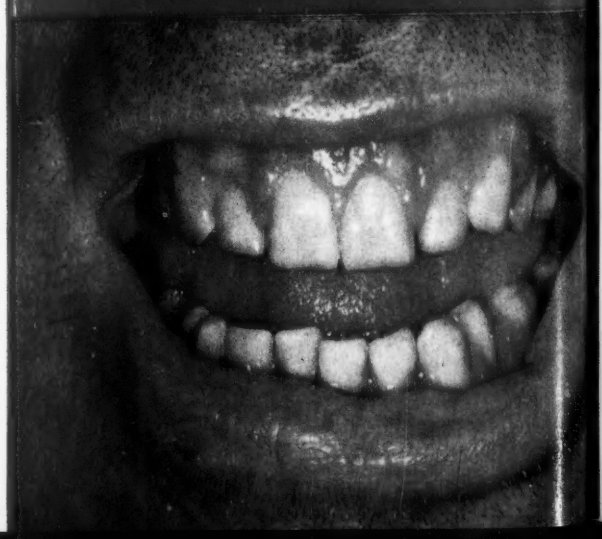
FIG. 3 Left. The dentogenic interpretation of youth in a denture.
FIG. 4 Above. Middle age expressed in tooth and matrix.
FIG. 5 Right. Tooth form color, portion and matrix suggest age.

FIG. 9

The conventional treatment of the interdental papillae area here is mechanical and unhygienic.

FIG. 10

Sex, personality and age are expressed in this meaningful interdental papillae treatment.



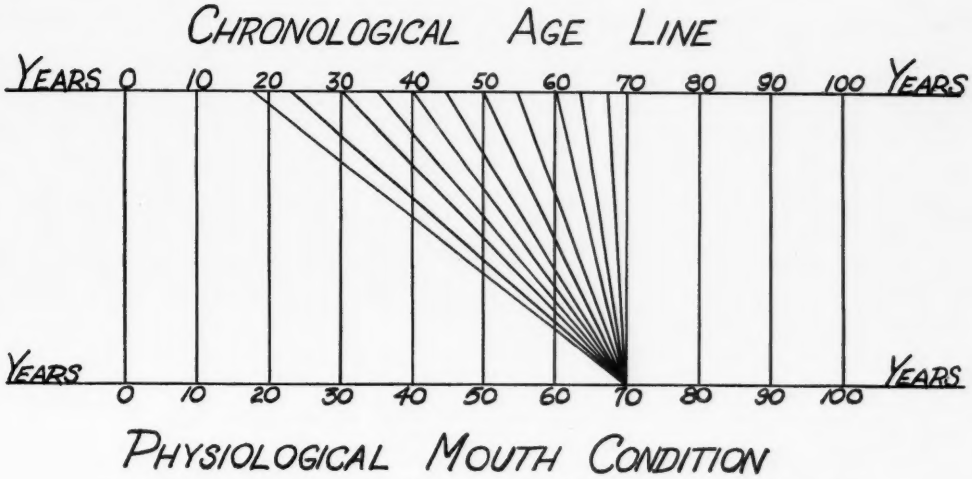

CHRONOLOGICAL AGE LINE
YEARS 0 10 20 30 40 50 60 70 80 90 100 YEARS
YEARS 0 10 20 30 40 50 60 70 80 90 100 YEARS
PHYSIOLOGICAL MOUTH CONDITION

Fig. 6.—Comparison of the chronologic age and the physiologic age of a patient.

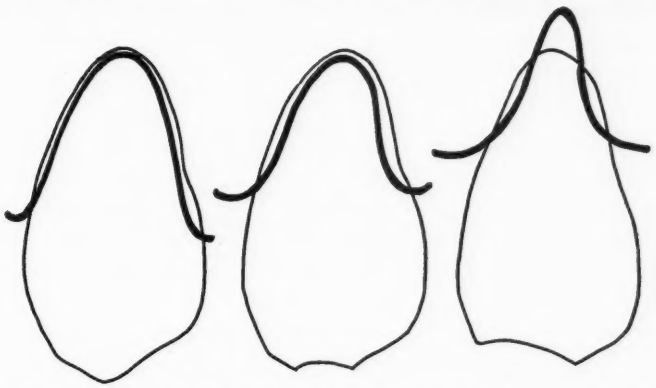


Fig. 7.—The changing cuspid tip with age. Left, youth; center, middle age; right, advanced age.

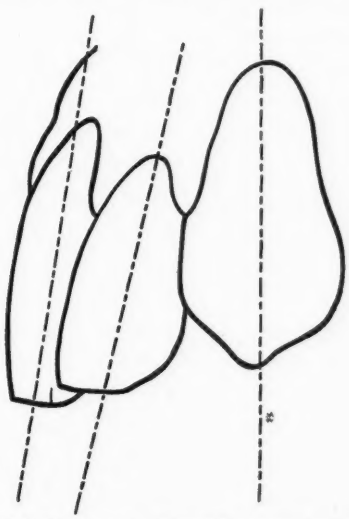


Fig. 8.—The variable long axes of teeth become accentuated with age.

AGE INTERPRETATION BY TOOTH POSITION

The loss of the so-called permanent teeth often starts in the early years of the life of the individual. It is quite common to see young people of 18 and 19 with some permanent teeth so involved with caries as to require extraction, and, of course, with each additional year more teeth are lost. Unless these teeth are replaced immediately, mouth deterioration assumes innumerable forms.

It is well then to recall, when constructing complete dentures, that effective age interpretation may be further enhanced by a consideration of the probable tooth loss and the consequent migration and drifting compatible with the natural teeth in a person of the same age.

Inasmuch as the age factor is complimentary to the personality factor, and the dentist undertaking to restore all the teeth is endowed with the creative license to ignore such conditions as he may deem unbecoming to the personality of the patient, the privilege is his to portray any degree of chronologic progress he may desire.

This artistic permission, to subdue such physiologic occurrences as may have caused serious destruction of the alveolar process that has permitted unsightly elongation or displacement of certain teeth, is of particular advantage. We have observed the maxillary anterior teeth extruded by malocclusion, and the cuspids, with the tips extending labially into the buccal corridor, creating wide spaces or diastemas between the teeth, making the tooth arrangement grotesque and ugly. Seldom would one ever want to reproduce a condition suggesting neglect of the teeth, but as the artist painting a tree which has survived adversity for many years sees the majesty of resistance to the elements in the gnarled and twisted branches, and conveys this to his canvas; so must the dentist consider his patient as an artistic challenge, and predetermine the appropriate dignity due the age and personality of his subject, as well as the sex, and achieve a representative positioning of the teeth in the denture compatible with his interpretation.

Advancement along the chronologic age line and the comparable progress physiologically are quite variable in individuals, but increasing age is to some degree physically noticeable in all people. Therefore, to keep denture restorations compatible with the physiologic progress of the individual, the dentist must be observant. It is not the purpose of the dentogenic concept to reproduce the undesirable results of age or to emphasize the mistakes of nature, but it does seek to avoid afflicting the individual with the even greater problem of appearing dentally out of harmony with his physical personality. Thus, it becomes obvious that age interpretation from a dental standpoint is a refinement of the personality factor.

Tooth position in the artificial denture then becomes important, in that imperfection is an artistic requirement in creating the illusion of natural teeth. This is opposed to the mechanistic alignment so frequently seen.

A condition so common in the natural teeth is the diastema. While occurring very frequently in youth, it is present even more often in the mouth of the adult in advancing years, because of the drifting of teeth resulting from premature loss of the permanent teeth. In the past, it has been seldom used in the artificial denture, except in its most undesirable position, that is, between the maxillary central

incisors. In Figs. 3 to 5 is shown the skillful use of the diastema, which we prefer to consider an artistic space. The dentist is his own artist, and with thoughtful consideration of the age factor, when arranging a dental composition, the diastema places in his hands a splendid opportunity to create successfully the illusion of reality.

We desire to point out also, in the factor of age in the position of artificial teeth, the importance of placing the teeth in the denture to convey the effect of variable long axes (Fig. 8). A close study of natural teeth in the mouth will disclose the subtle avoidance of mechanical repetition in the long axes of the teeth in nature. They do not appear to radiate from a common center as is sometimes seen in artificial teeth. It requires only the slightest rotation of a tooth to convey the illusion of its own individuality, totally separate from its neighbor. Of course this applies to all ages, but it can be exaggerated very successfully as the physiologic mouth condition demands. It lends itself in true character, particularly as an adjunct to the diastema.

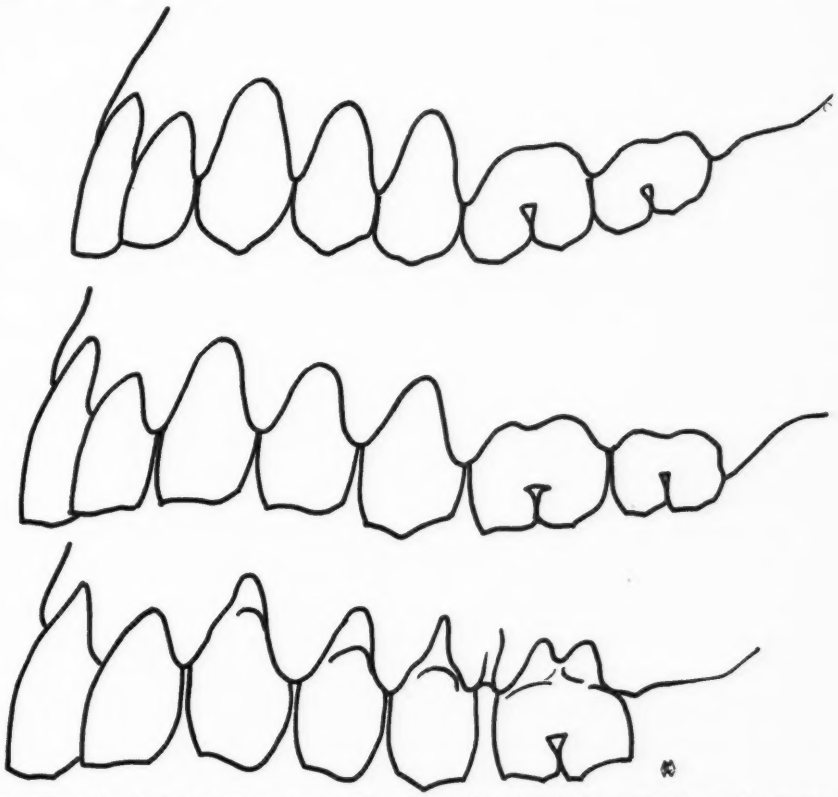


Fig. 11.—The interdental papillae *above*, of youth; *center*, of middle age; *below*, of advanced age.

AGE IN THE MATRIX

The tissues inside the mouth age as do tissues outside of the mouth, and unless some interpretation of the sex, personality, and age factors is made in the gum matrix (denture base) we ignore this fact. The environment of the tooth is as important as the tooth itself. The matrix of the artificial tooth must be meaningful

and not repetitive or inartistic. Our attempt in dentogenic restorations is to achieve the appearance of youth, middle age, or old age in the denture base according to the age of the patient, and according to the aging of the other tissues of the body. Colorwise, it is necessary to observe closely the color of the tissue in the mouth of the patient under consideration, as here the physiology of the individual plays a more important part than the age factor.

Nearly all of the conventional dentures which we have examined have a common interdental papillae design, as shown in Fig. 9. This design not only contributes to the mechanical "denture look," but also creates crevices and pockets for food impaction, plaque formation, and bacterial growth. This is a holdover technique from the days of the vulcanite denture base, when all efforts were made to hide all possible evidence of the matrix because of its unfavorable color. Today, with very lifelike materials available, we can even feature the interdental papillae in such a realistic manner as to greatly aid in the illusion of reality. Fig. 10 shows the result of an attempt to correct the faulty design shown in Fig. 9. In the diagram (Fig. 11), we observe the treatment of the matrix to convey youth, middle age, and old age in the interdental papillae. Age and pathology have taken their toll even as they do with the tissues out of the mouth. In youth, the interdental papillae are finely stippled and pointed and tight against the tooth. As age increases, Massler[2] says, "The attached gingivae lose their stippled appearance and appear edematous and smooth. The buccal mucosa is dry, inelastic and often wrinkled." Advancing age can be indicated appropriately by shortening of the papillae, and by raising the gingival gum line to suggest recession. This, added to the discreet management of the variable long axis of the teeth, and the judicious use of the diastema, opens up a new artistic world for the creative prosthodontist.

SUMMARY

Consideration of the age factor in dentogenics provides a means for intelligent, as well as artistic, correlation of the physiologic and chronologic life lines in the edentulous patient. No longer can it be acceptable to place dentures in patients' mouths which have no identity with the patients' general age structure.

The dignity of advancing age must be appropriately portrayed in the denture by careful tooth color selection and by mold refinement; also by the intervention of such characterization as would be fitting for the personality and sex of the patient.

Very often, we have observed people in advanced years with dentures displaying a complement of teeth which would seldom be found in the natural dentition of a teenager. This is thoughtlessness, and it is not only embarrassing to the patient but reflects very unfavorably upon the dental profession.

The positioning of the teeth in the denture base is the beginning in age interpretation, and it will be found that the subtle nuances of *early* age significance is usually more difficult to achieve than the imperfections associated with increasing age. The diastema so appropriate in the older interpretation must be used very judiciously in the more youthful interpretation.

It should be kept in mind that the qualities of age are present in the natural teeth as well as in other tissues of the body, and we must create the illusion of age to a satisfactorily artistic sense in our artificial substances.

The matrix in which the teeth are invested is a very important means of expressing the quality of age. Not only is this possible by the use of color in the matrix, but, even more important, by particular attention to the interdental papillae as to shape, length, and breadth. These are the subtle but powerful nuances at the command of the observing dentist.

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EDENTULOUS IMPRESSION PROCEDURES FOR MAXIMUM RETENTION AND STABILITY

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THE COMPLETE DENTURE PROBLEM poses a perpetual challenge to both the general practitioner and the prosthodontist. Its successful resolution depends upon many factors. The dentist's knowledge and possession of the necessary technical skills, plus the patient's willingness and capacity to persevere and master the use of well-constructed dentures are factors of major consideration, and vital to the ultimate result. The importance of a definite understanding with every patient prior to undertaking the construction of dentures cannot be overemphasized.

The attainment of maximum chewing efficiency[1] is a cardinal objective of the entire prosthetic procedure. For its realization, the procurement of maximum retention and stability without detriment to the underlying foundations is imperative.

Retention implies the power to counteract displacement in a direction immediately opposite the path of insertion.[2] It depends upon the forces of adhesion, cohesion, and atmospheric pressure.

Stability is predicated on the resistance to horizontal forces.[3] It is developed in the impression technique through more definite and intimate contact of the labial and buccal flanges with the labial and buccal slopes, and of the lingual flanges with the lingual slopes of the ridges.

The technique of choice should be in conformity with the over-all objective.

Boucher[4] has stipulated the following objectives of complete denture impressions: retention, stability, support, esthetic values, and preservation of the residual ridge.

According to Schlosser,[5] retention is governed by three major factors: uniform bearing over hard and soft areas, a good border seal, and a well-balanced functional occlusion for maintenance of both retention and stability.

Fish[6] states that the three principal factors in retention are (1) the bearing surface, (2) a balanced, harmonious occlusion, and (3) properly-formed polished surfaces.

Achievement of the basic goals demands maximum coverage without undue displacement of tissue, the development of a good border seal, and with adequate provision for resistant areas. Maximum buccal extension of the mandibular denture in the buccinator attachment zone, utilization of the retromylohyoid space,[7]

Presented as a projection clinic at the Greater New York Meeting, Dec. 6, 1954.
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Received for publication May 7, 1956.

and the sublingual crescent areas within physiologic limits will augment retention and stability.

A major impediment in the making of good impressions is the inability of many dentists accurately to define and limit border extensions.

With this in mind, it is the purpose of this article to present a technique that is fundamentally sound, devoid of excessively intricate manipulations, and within the realm of mastery by the average conscientious dentist.

Although no technique can be applied universally in all cases,[8, 9] a standardized procedure with slight occasional variations can be successfully employed for the vast majority of patients.

THE MANDIBULAR IMPRESSION

In making the lower impression, the resistant attachments must be recognized. These are the labial frenum, the buccal frenum, the distobuccal angle influenced by the masseter muscle, the distal attachment of the mylohyoid muscle, the lingual structures in the floor of the mouth, and the lingual frenum (Fig. 1).

The selection of a suitable tray is governed by the technique (Fig. 2).

The tray should be long enough to cover the retromolar pads, large enough to permit an adequate bulk of modeling plastic, and have lingual flanges that extend into the retromylohyoid spaces.

Approximately two cakes of Kerr red medium-fusing modeling plastic are used. After properly loading the tray, its undersurface is chilled with ice water from a water syringe. The colder layer will act as a plunger for the softer material above it, assure an adequate bulk of impression plastic, and prevent the seating of the tray too far.[10] The material is then reheated with the torch, tempered in water at 135° F., and inserted in the mouth. After chilling, the seal is first broken, then the impression dislodged, removed, and examined. This overextended impression should reveal the grooved outlines of the external and internal oblique lines, the frenum markings and the retromolar pads. The pads are generally relieved slightly with vulcanite scrapers. Any undercuts below the mylohyoid lines are reduced with a sharp knife. The impression (Fig. 3) need not be boxed. It is poured in stone.

On the cast made from the preliminary impression (Fig. 4), the approximate extent of the cold-cure tray to be constructed is outlined. This outline is accentuated by scratching into the cast with a sharp instrument. After processing, the inner ledge thus created serves as a guide for the rapid removal of overextension. Two pencil lines are drawn from one end of the cast to the other on the labial and buccal slopes, and on the lingual slopes slightly below the ridge crest (the distance dependent upon the height and character of the ridge).

Two layers of 28-gauge casting wax are warmed and molded into position between these lines. The objective is to relieve the crest of the ridge, to avoid overloading, and to provide for more definite contact of the tray along the slopes of the ridges in the final impression (Fig. 5).

The mandibular ridge, in most cases, is a secondary stress-bearing area. Relief of the ridge area, without relieving the slopes, will automatically ensure greater pressure on those areas not so relieved in the final impression.[11]

Fig. 1.

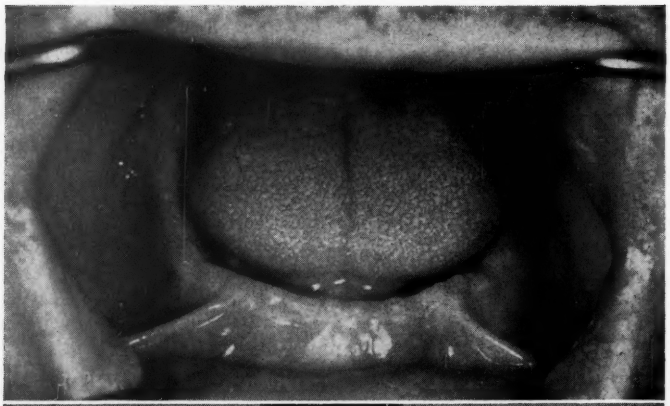

Fig. 2.

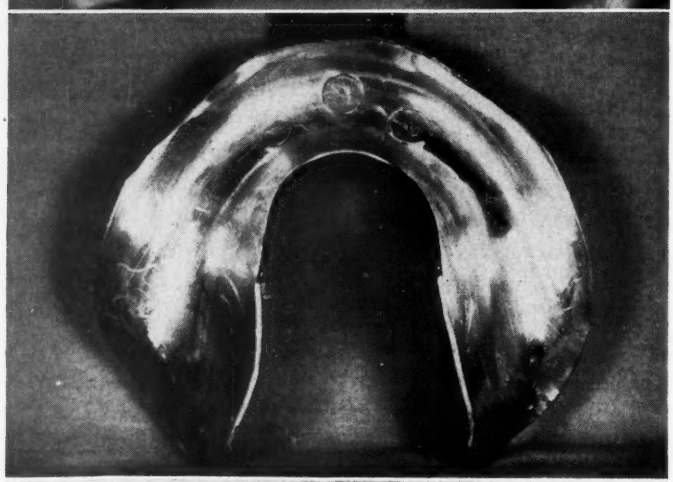

Fig. 3.

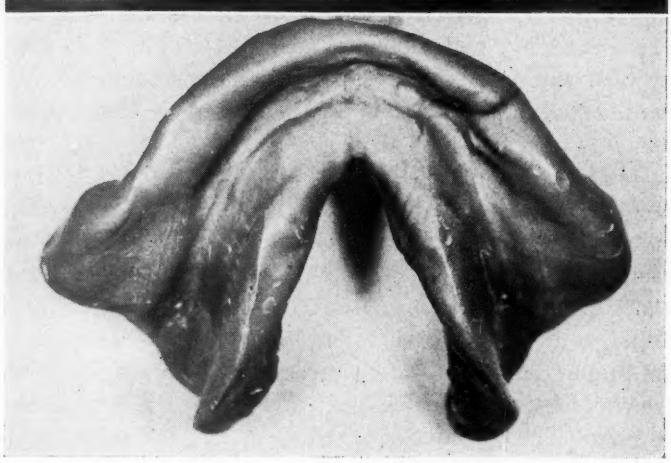

Fig. 1.—The lower denture foundation.
Fig. 2.—A stock metal tray for the lower preliminary impression.
Fig. 3.—The preliminary modeling plastic impression. The retromolar pads and undercut areas below the mylohyoid lines have been relieved.

The cast is lubricated with petroleum jelly, and a mix of a self-curing acrylic resin is made and molded into position. A tray with a short, wide handle is fabricated. The excess is trimmed on the lathe, and the tray is checked in the mouth for overextension.

Fig. 4.

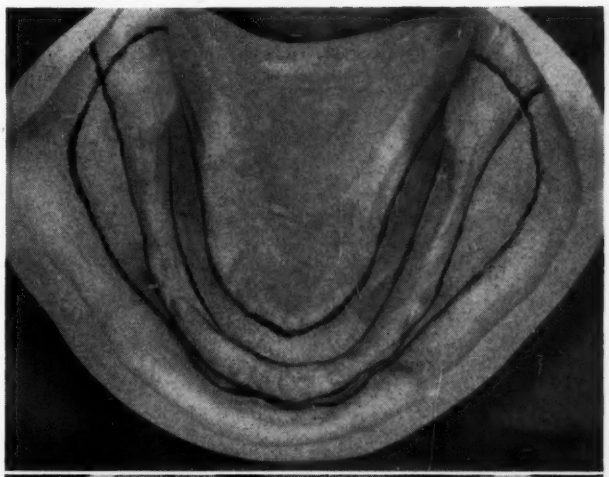

Fig. 5.

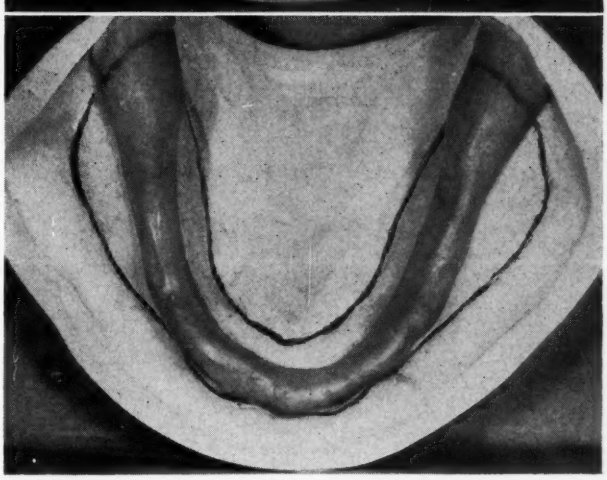

Fig. 4.—The preliminary lower cast. The approximate extent of the cold-cure tray to be constructed, and the ridge area for the placement of relief wax is outlined in pencil.

Fig. 5.—The preliminary cast showing the ridge area relieved with two layers of 28-gauge casting wax.

The tray (Fig. 6) should be a trifle short of the mucosal flexure, labially and buccally. Lingually, it should barely contact the tissues of the floor of the mouth. The distal portion of the lingual flange should extend into the retromylohyoid space. The tray is then border trimmed in sections, labially and buccally, using low-fusing Kerr gray modeling plastic sticks. All border trimming is done manually. Low-fusing stick plastic is added to the distal portion of the lingual flange, heated, tempered, and the tray is returned to the mouth. The patient is requested to make repeated protrusive thrusts of the tongue slightly beyond the lower lip. The lower

Fig. 6.

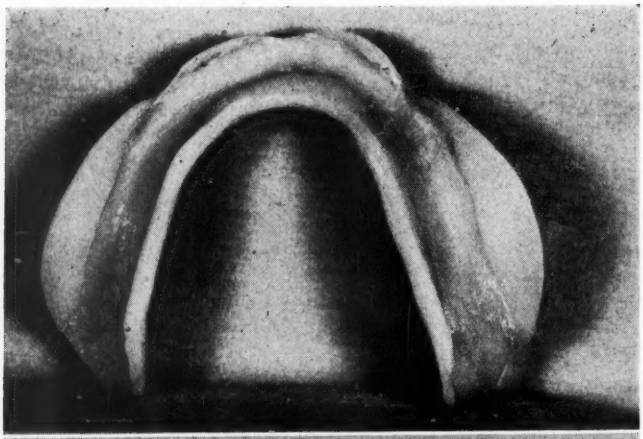

Fig. 7.

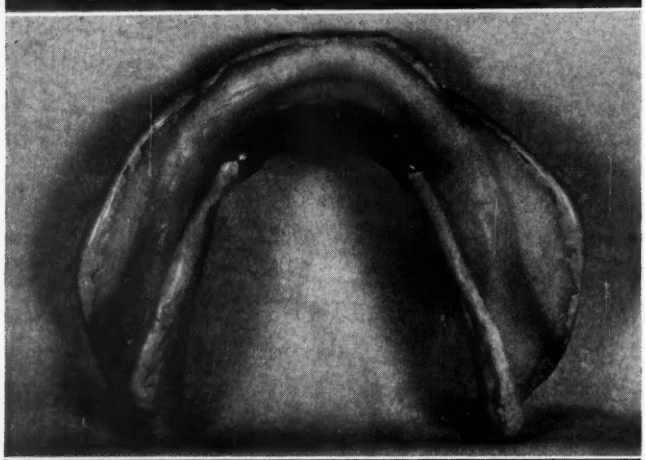

Fig. 8.

Fig. 6.—The acrylic resin tray trimmed and ready for border molding.

Fig. 7.—The border molded lower tray prepared for the zinc oxide and eugenol impression material.

Fig. 8.—The final lower impression.

border of the lingual flange is developed by repeated protrusive thrusts of the tongue into the opposite cheek. In the sublingual crescent region, about a third of a medium-fusing red plastic stick is heated, arbitrarily fashioned to extend in a shelflike manner posteriorly, and luted to the tray with a hot instrument. In the midline, it is extended posteriorly about 4 or 5 mm., tapering away to nothing in the premolar regions. The undersurface of this extension is heated, tempered, and the tray is returned to the mouth. The patient is requested to maintain the tongue at a position near the top of the handle, moving it gently from one corner of the mouth to the other, while the operator steadies the tray in the mouth with the index fingers and with the thumbs of both hands under the mandible. This procedure is repeated several times in order to reduce to a minimum any possibility of pressure on the tender underlying tissue (Fig. 7).

Frequently, the individual variations in the anatomy in this region will not permit of any sublingual extension. Undue limitation of tongue movements, and possible obstruction of the ducts of the submaxillary glands should be avoided. A lingual border that is too thick may interfere with phonetics. If it is too thick, it is an invitation to the accumulation of calculus with resultant tissue irritation.

The tray is dried, loaded with a mix of a hard-setting impression paste, carried into the mouth, and held gently in position. About one-half to one minute should elapse before border molding is begun in order to obtain a more uniform and equitable distribution of the material. The patient is informed to keep the tongue near the top of the handle and, when requested, to repeat the previous movements; then, while the impression paste is setting, merely to keep the tongue motionless near the top of the tray. Labially and bucally, the border molding is accomplished manually by the operator. The cheek is lifted up and out and then manipulated backward and forward to provide freedom for the buccal frenum. The lip is moved up and out and then from side to side to accommodate the labial frenum.

The impression (Fig. 8) is carefully boxed and poured in stone. Immediately after pouring, while the stone is still soft, a Stansbery mounting plate is gently placed in position to facilitate subsequent remounting (Figs. 9 and 10).

THE MAXILLARY IMPRESSION

The resistant attachments in the upper jaw are the labial and buccal frenula. Undue posterior extension of the maxillary denture may encroach upon the pterygomandibular raphé, and should be avoided. The torus palatinus must be relieved when it is prominent. The incisive papilla always requires relief in order to protect the blood and nerve supply underneath it. The natural protection afforded the greater palatine foramen by the palatine glands, which are 4 to 6 mm. in thickness, obviates the need for relief in this region. The buccal space opposite the tuberosity must be observed carefully to assure adequate filling of this space. Overfilling, however, may invite dislodgment of the denture. The posterior limits of the denture are automatically determined by the location of the hamular notches and the vibrating line (Fig. 11).

The tray selected should be of a size large enough to permit of a uniform bulk of about 4 mm. of material (Fig. 12).

Two cakes of Kerr white medium-fusing modeling plastic are used for the average patient. The tray is dipped in hot water to facilitate the subsequent separation of the tray from the modeling plastic. The tray is loaded with the impression material, and the undersurface is chilled with ice water from a water syringe. The

Fig. 9.

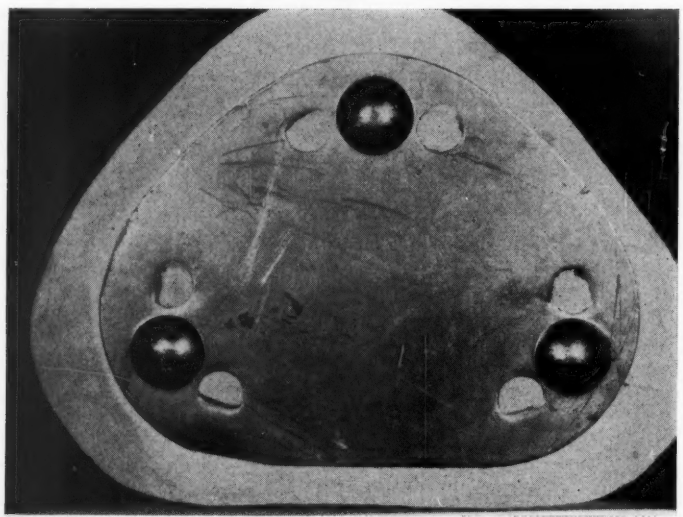

Fig. 10.

Fig. 9.—The Stansbery mounting plate in position after pouring up the impression.
Fig. 10.—The master cast.

impression material is reheated with the alcohol torch, tempered in water at 135° F., and inserted in the mouth. It is chilled, the seal broken, and the tray is dislodged and removed by the handle. The impression should have good tissue detail (Fig. 13).

The vibrating line is located. The palate is dried with 2 by 2 inch gauze pads, the patient is requested to say "Ah," and when the line becomes apparent, it is marked with indelible pencil (Fig. 14). With the mouth still open, the operator

Fig. 11.

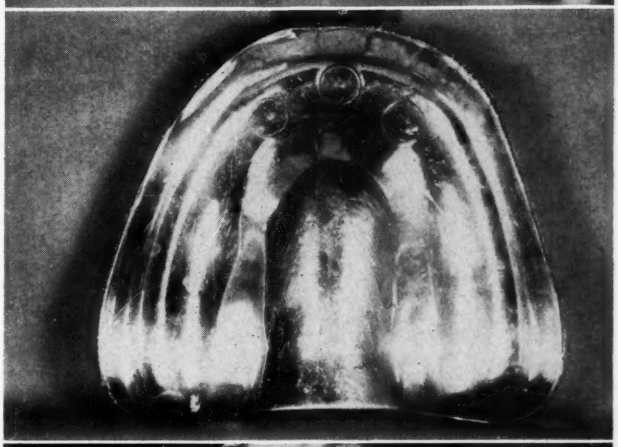

Fig. 12.

Fig. 13.

Fig. 11.—The maxillary jaw.
Fig. 12.—The stock metal tray for the upper preliminary impression.
Fig. 13.—The preliminary impression after the first insertion.

distends the patient's lips and cheeks horizontally. These tissues are dried with gauze pads, and lines are quickly drawn at the lowest point of the mucosal flexure with indelible pencil (Fig. 15).[12]

Fig. 14.

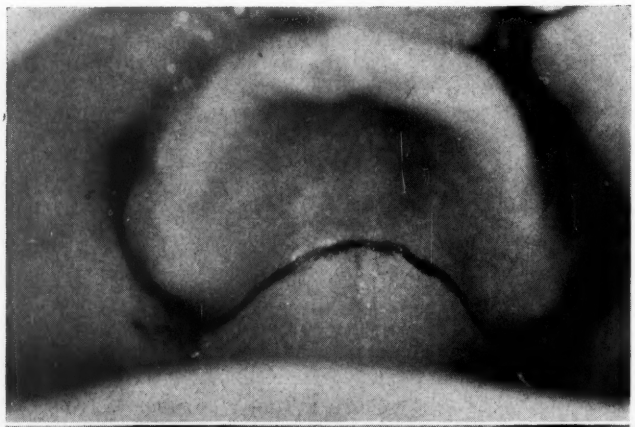

Fig. 15.

Fig. 16.

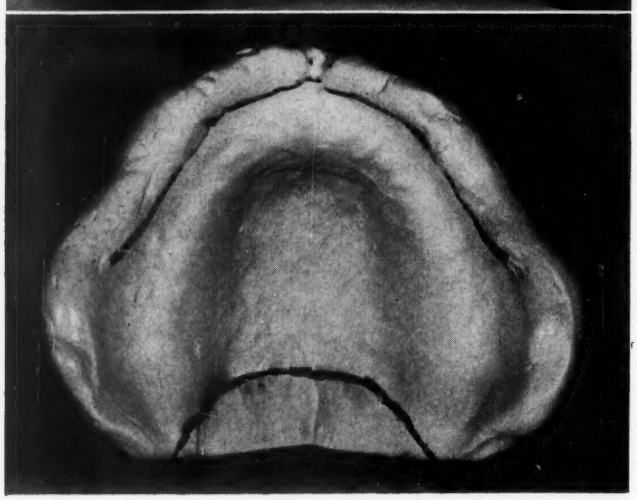

Fig. 14.—The vibrating line marked in the mouth with an indelible pencil.

Fig. 15.—The lowest point of the mucosal flexure is marked with an indelible pencil while the lips and cheeks are distended horizontally.

Fig. 16.—The indelible markings are transferred to the reinserted preliminary impression.

The impression is dried with an air blast and quickly carried back into the the mouth for the purpose of transferring the indelible pencil markings on to the impression (Fig. 16). When removed from the mouth, the impression is pried loose from the tray. With a sharp knife, the flanges are reduced to the markings just obtained. All cutting is done at right angles to the inner surface of the flanges.

Fig. 17.

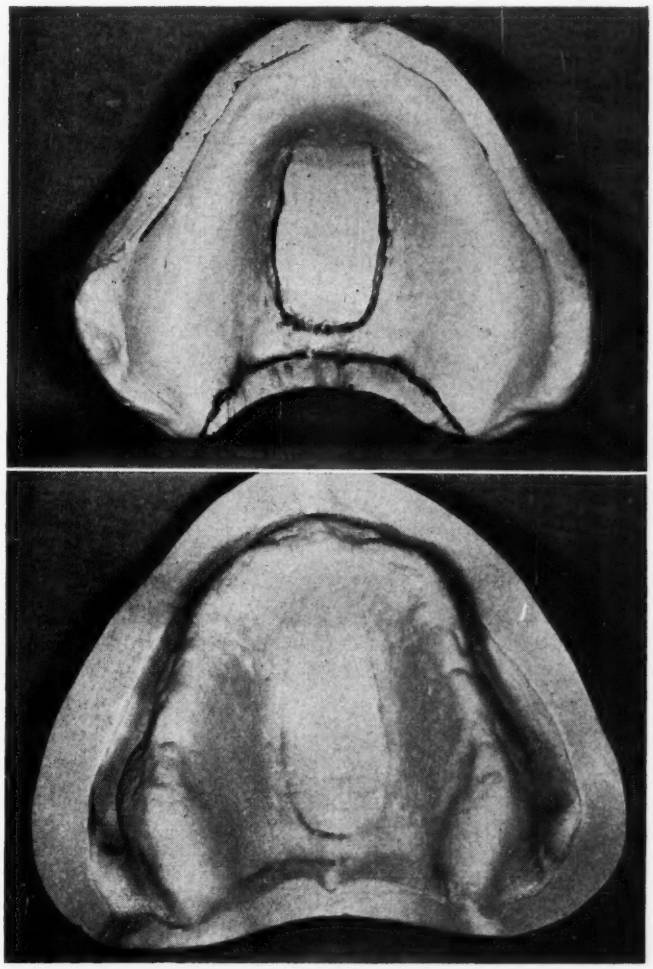

Fig. 18.

Fig. 17.—The preliminary impression is cut back to the indelible pencil markings after separation from the stock tray. Posteriorly, the impression extends about 3 mm. beyond the vibrating line. The incisive papilla, torus palatinus, and prominent rugae have been relieved.
Fig. 18.—The preliminary upper cast.

Posteriorly, the excess material is reduced until it extends about 3 mm. beyond the vibrating line. The incisive papilla and the torus palatinus, if prominent, are located and outlined on the impression. These areas, as well as any prominent rugae, are relieved in the impression with vulcanite scrapers (Fig. 17). A cast is poured in stone (Fig. 18).

Fig. 19.

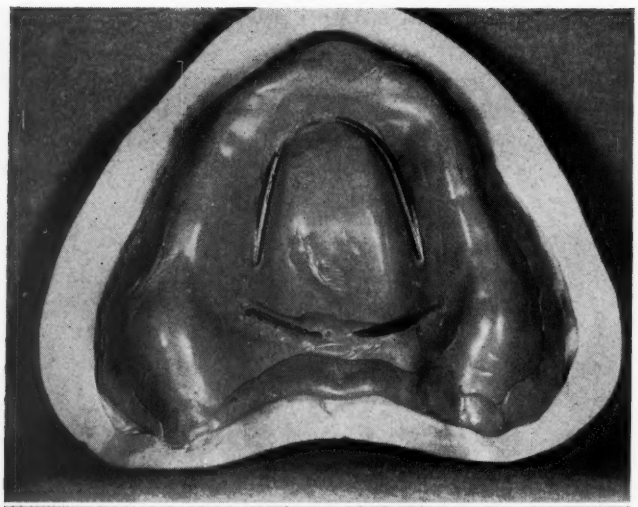

Fig. 20.

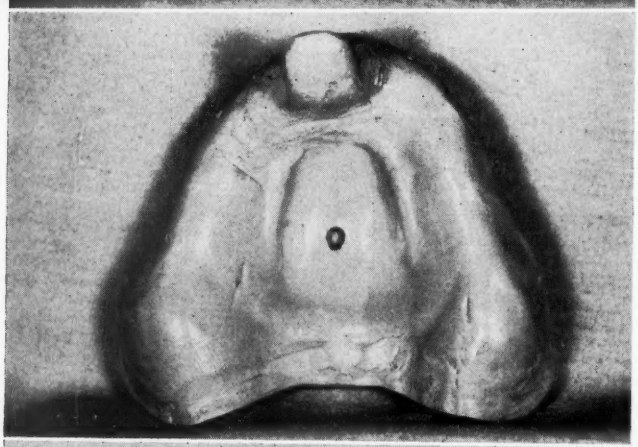

Fig. 21.

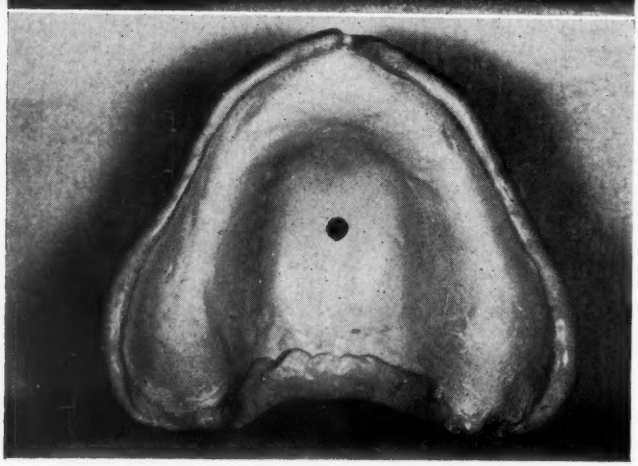

Fig. 19.—A single thickness of baseplate is adapted to the preliminary cast with 14-gauge reinforcement wires in position.

Fig. 20.—The reinforced tray prepared for border molding.

Fig. 21.—The border molded tray is ready for the zinc oxide and eugenol impression material.

A rigid, less cumbersome and well-fitting tray can be quickly fabricated over this cast from a thin baseplate material. Undercut areas on the cast are relieved with Plasticine, and a single thickness S. S. White trial baseplate is adapted to the cast. Two individual pieces of a 14-gauge wire are now contoured, heated, and sizzled into position on the baseplate. One is placed posteriorly across the tray, and the other (U-shaped) to conform to the anterior portion of the palate (Fig. 19). An additional single thickness of the same baseplate material is now warmed

Fig. 22.

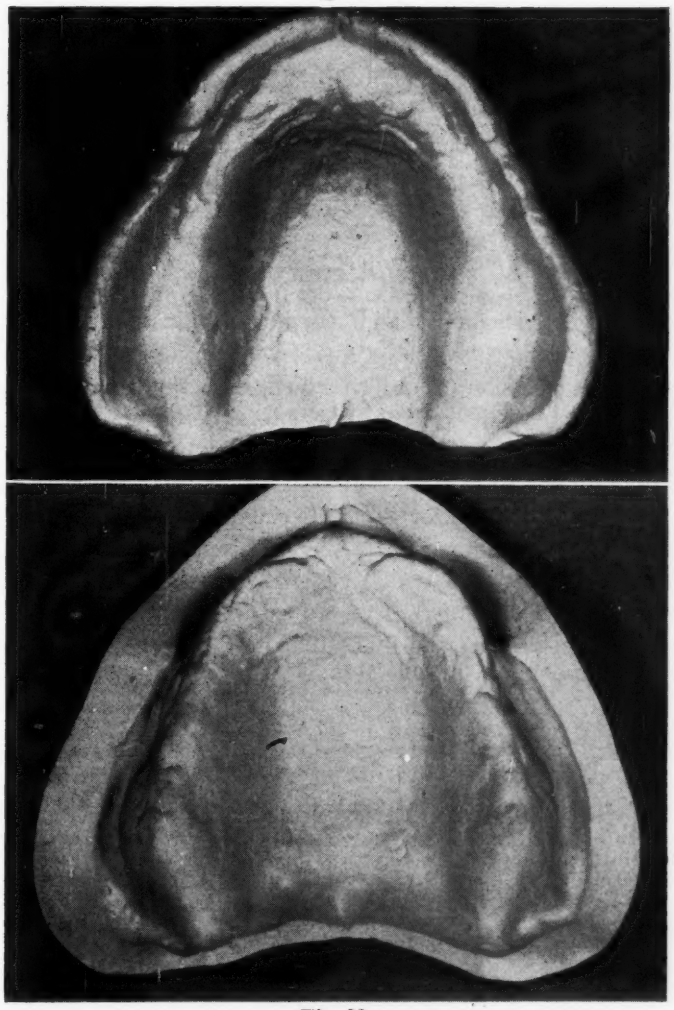

Fig. 23.

Fig. 22.—The final upper impression.
Fig. 23.—The final cast.

and fused to the first in order to provide additional strength and rigidity. A handle is fashioned from the excess material and luted to the tray. A hole is drilled through the center of the tray at the midline with a No. 12 round bur, in order to relieve the pressures that are generally built up in this region when a mass of impression material is thus confined (Fig. 20).

The upper tray is now border molded in sections, labially and buccally, using a low-fusing gray modeling plastic stick. The border molding is accomplished manually. To provide for the buccal frenum, the cheek is raised up and out, and pulled down and in and then forward and backward. To provide for the labial frenum, the lip is raised up and out, and pulled down and in, and then moved from side to side. The distobuccal angles of the tray are developed by having the patient swing the mandible from side to side with the mouth slightly open. Some low-fusing modeling plastic material is added in the postpalatal seal area in order to assure more definite and intimate contact of the tray with the tissues in this region (Fig. 21).

The tray is dried, loaded with a mix of hard-setting impression paste, carried to the mouth, and held gently in position. After waiting about one-half to one minute, border molding is accomplished by repeating the movements previously mentioned. The impression (Fig. 22) is now carefully boxed, poured in stone, and a mounting plate is inserted in its base.

SUMMARY

A thorough diagnostic survey and a critical evaluation is essential before making adequate impressions.

A standardized impression procedure which, with slight occasional variations, will suffice for the vast majority of patients has been described.

A method of delineating correct border extensions has been described.

Careful execution of all the various steps in the technique will assure the realization of the objectives and uniformly gratifying results. The procedures suggested are basically sound, comparatively simple to apply, and can be mastered by any conscientious dentist.

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THE MANAGEMENT OF ABUSED ORAL TISSUES IN COMPLETE DENTURE CONSTRUCTION

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IT IS EXTREMELY IMPORTANT that the soft tissues that have been abused and deformed by ill-fitting dentures be allowed to recover and return as closely as possible to normal form before impressions for new dentures are made.

The purpose of this article is to emphasize the need for permitting abused tissues to recover, and to suggest measures for accomplishing their recovery.

DIAGNOSIS

When patients who have been wearing complete dentures are examined for new dentures, all abnormalities of the soft tissues beneath the dentures must be recognized and treated. Such abnormalities may result either from systemic disturbances or from mechanical factors caused by ill-fitting dentures.

Current literature indicates that the prosthodontist is becoming increasingly aware of the necessity for improving the patient's general health in order to preserve the structures that support dentures. The cooperation of the prosthodontist and the physician is often necessary for the correction of unfavorable systemic factors.

Diagnosis and treatment of systemic and mechanical causes of abnormal conditions must be considered separately; however, the respective treatments may be carried on concurrently. Although the diagnosis and treatment of abnormalities caused by mechanical and systemic factors each warrant discussion, this article is limited to consideration of the mechanical factors.

Evidence of mechanical abuse of the soft tissues beneath complete dentures may vary from slight displacement in some cases, to trauma and gross deformation in others (Fig. 1). The soft tissues beneath ill-fitting dentures are actually trapped between the denture base and the underlying bone. Ill-fitting dentures may alter the character, condition, and form of the underlying soft tissues. The form of these tissues may be affected by the stresses transmitted through the denture by the shape and areal coverage of the denture impression surface, and by the contour and consistency of the underlying bone.

When the soft tissues beneath denture bases are displaced within normal physiologic limits, they tend to return to their rest form. If, however, the soft

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The opinions or assertions contained herein are the private ones of the author and are not to be contrued as official or reflecting the views of the Navy Department or the Naval Service at large.

Read before the American Denture Society and the Pacific Coast Society of Prosthodontists in San Francisco, October 14, 1955.

Received for publication May 2, 1956.

tissues beneath dentures are subjected to excessive stress, they not only become deformed and traumatized, but they also become less resilient and do not readily return to their normal form. There may be clinical evidence of hyperemia, and histologic examination may reveal inflammatory changes.

Abnormal conditions of the soft tissues must be recognized in the diagnostic phase of treatment and these conditions corrected before new dentures are constructed.

TISSUE RECOVERY

When dentures that have caused trauma and deformation of the underlying soft tissues are removed, the tissues improve in tone and return to a more normal form. This may be called tissue recovery (Fig. 2).

Fig. 1.

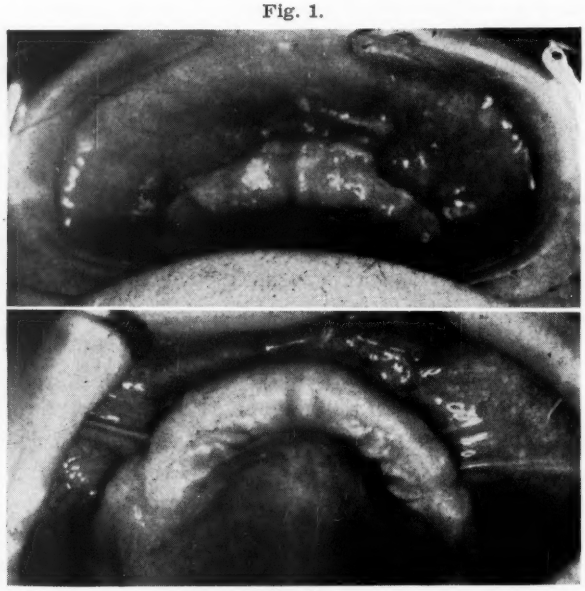

Fig. 2.

Fig. 1.—Abused and deformed soft tissues caused by an ill-fitting denture.
Fig. 2.—Recovered soft tissues (the same arch as in Fig. 1) after the ill-fitting denture was left out of the mouth to permit the soft tissues to return to a more normal form.

The time necessary for recovery of deformed soft tissues of the basal seat is influenced by the general health of the patient. Generally, the ridges of young, healthy individuals will recover more rapidly and completely than those of older patients. This may be due to two causes: first, their ridges usually show more deformation than those of the older patients because of the comparatively higher tone of their muscles of mastication; second, the tissues return more rapidly to a normal form and tone because of the healing capacity of youth.

METHODS USED TO OBSERVE AND STUDY THE MAGNITUDE OF THE CHANGE IN FORM OF SOFT TISSUES IN EDENTULOUS PATIENTS

When abused soft tissues beneath ill-fitting dentures are allowed to recover, the changes in form that occur are significant, and will influence the various phases

in the construction of new dentures. The magnitude of these changes may be observed and studied in several ways.

1. When ill-fitting dentures are removed to permit tissue recovery, the change in form and tone of the soft tissues of the denture-supporting area may be observed clinically (Figs. 3 and 4).

2. If impressions are made with a free-flowing material before and after tissue recovery, cross sections of casts from these impressions can be compared to show the magnitude of the change in contour (Figs. 5 and 6).

Fig. 3.

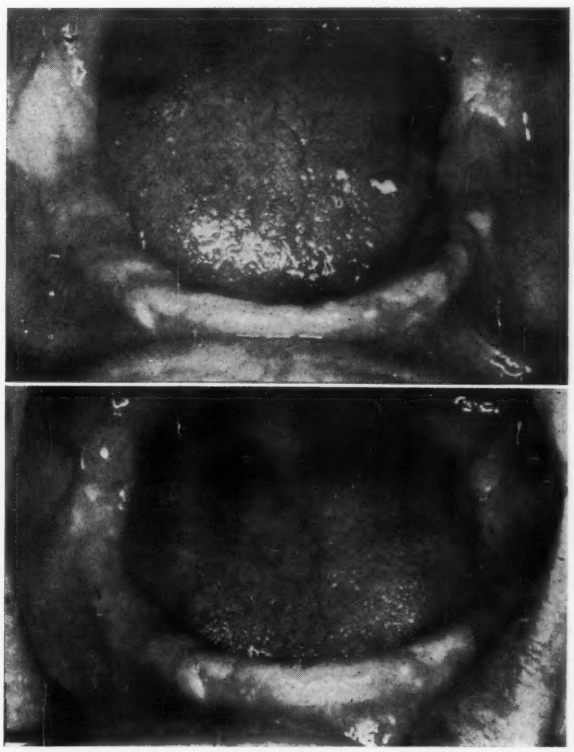

Fig. 4.

Fig. 3.—Abused and deformed soft tissues seen upon removal of an ill-fitting denture.
Fig. 4.—Recovered soft tissues after the ill-fitting denture was left out of the mouth for 60 hours. Note the change in form as compared with Fig. 3.

3. An instrument known as a dental comparator,* which operates on the principle of the pantograph, can be used to compare the contour of casts from impressions made with a free-flowing material before and after soft tissue recovery (Figs. 7 and 8). Because we are dealing with variable living tissues, it is difficult to secure exact measurements. However, in general, we can say the changes in the contour of the soft tissues that occur with tissue recovery are significant.

*The basic instrument is known as the dentograph, designed and manufactured by G. R. Kern, with modifications for the purpose of comparative measurements made at the National Bureau of Standards by N. W. Rupp, George Dickson, M. E. Lawson, Jr., and W. T. Sweeney. An article describing this instrument has been accepted for publication by the *Journal of the American Dental Association.*

4. Roentgenograms made before and after tissue recovery offer other evidence of change. A thin strip of metal foil placed on the mucosa of the ridge crest makes it possible to compare the contour and thickness of the soft tissues (Figs. 9 and 10).*

5. Cephalometric roentgenograms† made with the dentures in place help show the position of the dentures in relation to the bony landmarks of the mandible and skull. Metal markers placed in the impression surface of the denture base

Fig. 5

Fig. 6.

Fig. 7.

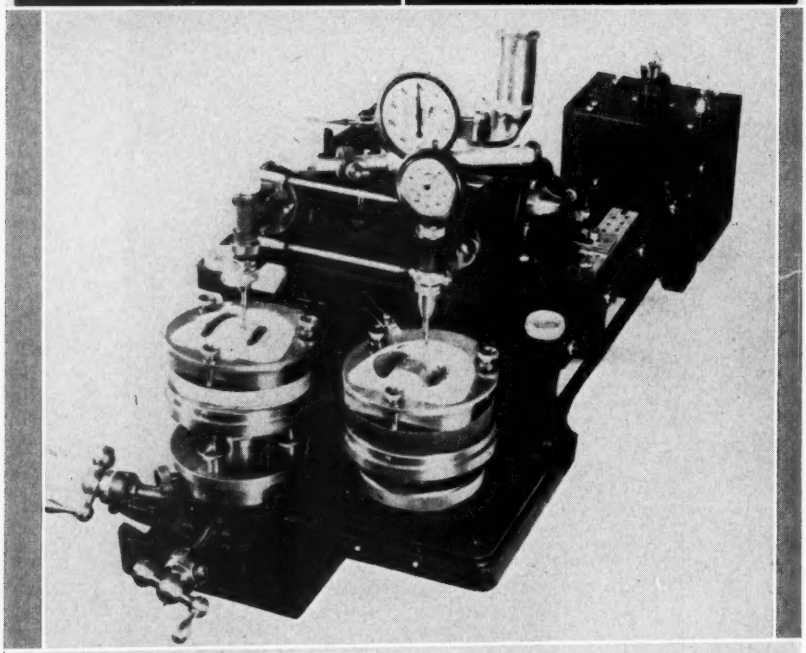

Fig. 8.

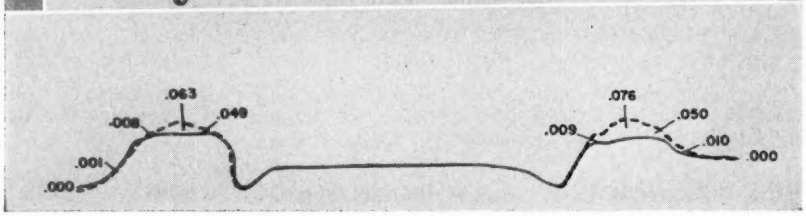

Fig. 5.—Cross section of a cast from an impression made before tissue recovery.

Fig. 6.—Cross section of a cast from an impression made after recovery of the same arch seen in Fig. 5. Note the change in ridge contour.

Fig. 7.—The comparator, an instrument for measuring the mucosal surface contours of impressions, casts, and dentures.

Fig. 8.—Cross section of first molar region. *Solid line,* Contour of the cast from an impression made before tissue recovery. *Broken line,* contour of the cast from an impression made after tissue recovery. The difference between the two casts is indicated in thousandths of an inch.

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*This method of study was suggested by Carl O. Boucher.

†Cephalometric roentgenographic studies were made at the National Institutes of Health, Bethesda, Md.

in the bicuspid and molar regions make this method of study more exact. Ill-fitting dentures that have deformed the soft tissues of the denture-supporting area may show gross changes in their position, in relation to bony landmarks, when they are replaced on tissues that have recovered their normal form (Figs. 11 and 12). These changes are accompanied by loss of retention, lack of stability, and changes in the occlusal relationship of the dentures. A study of these changes reveals an important fact: The soft tissues of the denture-supporting area may accommodate ill-fitting dentures; and because of their ability to make this accommodation, gross occlusal discrepancies may be concealed, and the retention and stability manifested may be at the expense of the health of the soft tissues.

The changes in form concurrent with the recovery of the soft tissues have an effect on impressions for new dentures and jaw relation procedures.

Fig. 9.

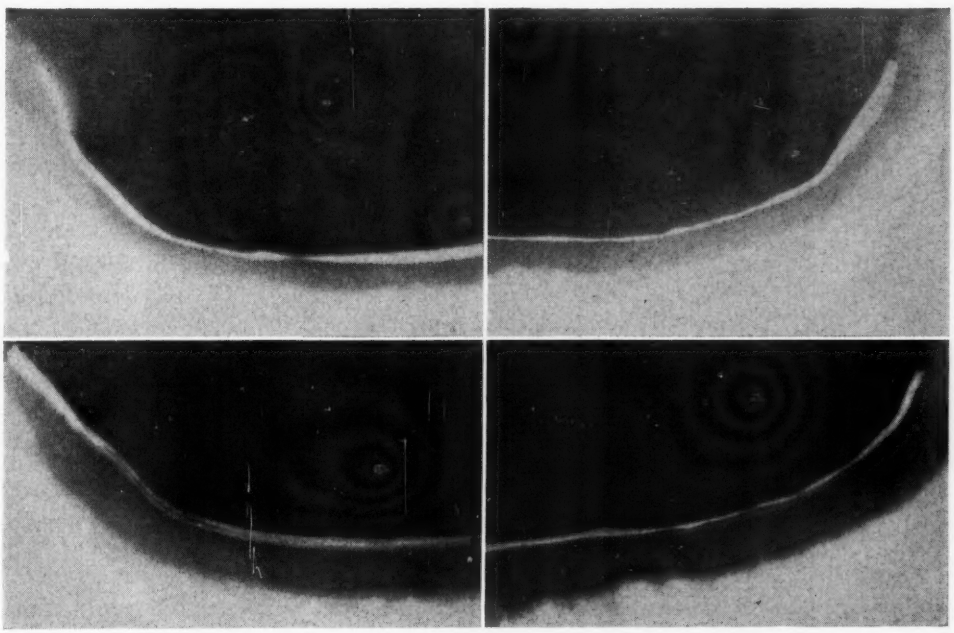


Fig. 10.

Fig. 9.—Roentgenograms made before tissue recovery. Note the thickness of the soft tissues over the ridge crest.

Fig. 10.—Roentgenograms made after tissue recovery of the same case as in Fig. 9. Note the thickness of the soft tissues over the ridge crest.

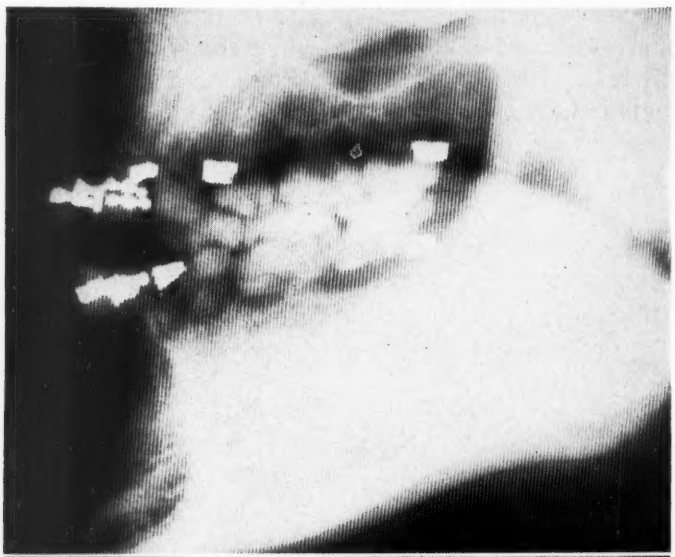
IMPRESSIONS

Soft tissues of the denture-supporting area that have been subjected to the abuse of an ill-fitting denture are not in a satisfactory conditon for impressions for a new denture. Inflammation and deformation of the soft tissues may exist in the areas that have been subjected to excessive pressures.

The improvement in tissue tone, usually noted under a new denture that has been constructed on casts from impressions made on traumatized and deformed

soft tissues, may be explained by the facts that the new denture is usually more stable and there is better distribution of forces to the supporting structures. Nevertheless, the contour of the impression surface of the denture is not acceptable. The dentist who believes the impression surface should be a negative reproduction of the soft tissues at rest would not accept an impression made of deformed tissues;

Fig. 11.



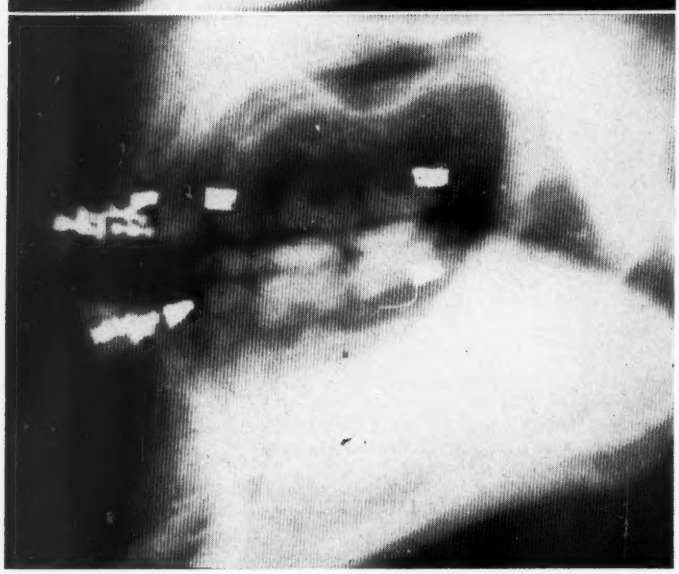


Fig. 12.

Fig. 11.—A section of a cephalometric roentgenogram made before tissue recovery. Note the relationship of the metal marker to the bone in the mandibular molar area.

Fig. 12.—A section of a cephalometric roentgenogram made after tissue recovery. Note the relationship of the metal marker to the bone in the mandibular molar area. Compare with the same landmarks in Fig. 11.

he would know that deformed tissues are not tissues at rest. On the other hand, the dentist who believes the impression surface should reflect the functional form of the tissues would not accept it either; he would know that an impression of deformed tissues is not an impression of tissues in their true functional form.

If an impression were made of a ridge where the soft tissues had been allowed to recover (see Fig. 4), and if the impression tray protruded through the impression material and excessively displaced the soft tissues on the crest of the ridge, the impression would not be acceptable. It would be rejected because the areas where the tray showed through might be damaged by excessive pressures.

If, however, a seemingly ideal impression of a ridge that had been traumatized and deformed by an ill-fitting denture (see Fig. 3) were accepted, pressure areas of far greater consequence might be perpetuated. In order to eliminate pressure areas that might destroy the supporting structures, abused soft tissues must be allowed to recover and return to a more normal form before impressions are made for new dentures.

JAW RELATIONS

Deformed soft tissues of the denture-supporting area prevent the obtaining of proper jaw relation records. The primary aim in registering jaw relations is to record the relationship of the mandible to the maxillae (a bone-to-bone relationship).

If the record bases could be placed directly on the bone instead of on variable soft tissues, the prosthodontist would have less difficulty recording jaw relations. Jaw relation records made when the soft tissues overlying the mandible and maxillae are deformed (see Figs. 3 and 9) will be different from records secured when the trial bases are placed on tissues that are in a more normal anatomic form (see Figs. 4 and 10). It can be seen readily that records made of the relationship of the mandible and maxillae when these bones are covered with deformed soft tissues are not acceptable. These records would not satisfy those who believe jaw relation records should be made without pressure or those who believe jaw relations should be recorded under the pressure of closure.

Since the prosthodontist must deal with soft tissues overlying the mandible and maxillae, he must consider not only the pressure during the recording of jaw relations, but also the condition and form of the tissues at the time the records are made.

STABLE RECORD BASES

Making proper jaw relation records requires the use of stable record bases. To be stable, a record base must have an impression surface that had an acceptable adaptation to the tissues beneath it.

Record bases that properly fit soft tissues in a normal form will not be stable if they are placed on soft tissues that have been deformed again by an ill-fitting denture after the impression was made (see Figs. 13 and 14). With this in mind one can readily see the advantage, in patients with easily displaced tissues, of securing jaw relation records the same day the impression is made. If this is not practical, satisfactory results may be obtained by controlling the form of the soft

tissues of the denture-supporting areas. Control measures may include leaving the dentures out at night and for a period of at least twelve hours before recording jaw relations, as well as before the try-in and final placement of the new dentures. A soft diet should be prescribed. A temporary relining made of a free-flowing material in the old dentures may help control the form of the soft tissues.

The patient's initial impression of a new denture is very important. A new denture will be more comfortable and create a more favorable impression on the patient if it is stable, and if the denture base adapts well to the soft tissues when the denture is first placed in the mouth. This requires that the soft tissues be in an acceptable form, similar to the form when the impression was made.

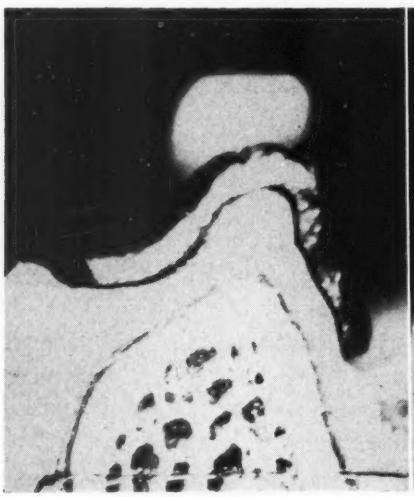


Fig. 13.

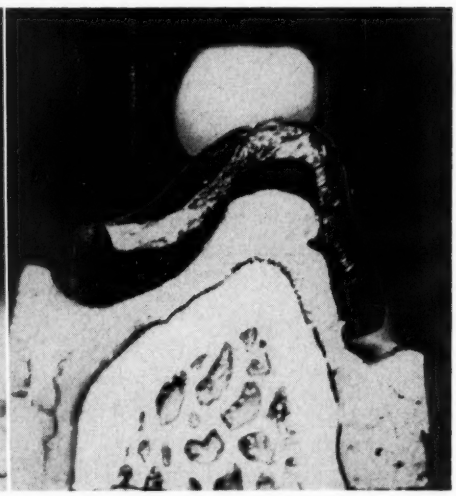


Fig. 14.

Fig. 13.—Satisfactory adaptation of a record base. The record base was placed on a facsimile of the mandible with the soft tissues in a normal anatomic form to illustrate satisfactory adaptation.

Fig. 14.—Unsatisfactory adaptation of a record base. Compare with Fig. 13. The same record base was placed on a facsimile of the same mandibular arch where the soft tissues were deformed by an ill-fitting denture that was worn after the impressions were made on recovered soft tissues.

FREE-WAY SPACE

Dentures functioning on deformed, traumatized tissues with a minimum of free-way space sometimes exhibit no free-way space when they are replaced in the mouth after the soft tissues have recovered and returned to a normal form.

It is believed that, in many of these cases, the dentures were constructed with an occlusal vertical dimension greater than the vertical dimension of physiologic rest, and that the free-way space which existed before recovery was at the expense of the underlying soft tissues, causing them to be deformed and traumatized.

REFITTING COMPLETE DENTURES

Failure to obtain satisfactory results in the refitting of complete dentures can often be traced to changes in the form of the soft tissues that occur during the time between the impression phase and the placement of the refitted denture.

Complete dentures should be left out of the mouth for forty-eight to seventy-two hours before impressions are made for refitting dentures, to allow the soft tissues of the denture-supporting areas to return to a more normal form.

The magnitude of the change in the form of the soft tissues that occurs when dentures are left out of the mouth is an important diagnostic aid, and often indicates whether dentures can be satisfactorily refitted or whether new dentures are indicated. For example, when there is marked trauma and deformation of the soft tissues of the denture-supporting areas, the gross changes that occur when the dentures are left out often result in loss of retention, loss of stability, and gross occlusal disharmony. This situation causes the denture to be uncomfortable to the patient, and helps to obtain his cooperation in accepting a treatment plan for a new denture.

PATIENT COOPERATION

The general surgeon may hospitalize his patient for study, conditioning, and preparation prior to an operation. The manner in which the surgeon presents his diagnostic findings, his explanation of the necessity for this prior treatment, and the confidence the patient has in the surgeon all prompt the cooperation of the patient.

If prosthodontists are to render a true health service, they also must be able to present treatment plans to their patients in a manner that will establish maximum confidence and obtain patient cooperation. The patient should be shown the conditions that exist in his mouth; he should learn the objectives of restoring the health of the oral tissues; and he should understand why certain measures by both the prosthodontist and himself are required to make the treatment successful. The patient should understand that the degree of health of the oral tissues not only determines the life of the dentures but also affects their efficiency and comfort.

To convince the patient of the need for his cooperation, a hand mirror may be used to point out abnormal conditions, such as inflamed tender areas. Study casts to call attention to changes in the form of the soft tissues, and roentgenograms to show the conditions of the osseous supporting structures are indispensable aids in presenting treatment plans for tissue recovery. The more the patient is shown and taught about his oral condition, the more cooperative he will be. Unsatisfactory results may occur if the prosthodontist does not seek the cooperation of the patient, and the patient feels no personal responsibility.

Cooperation in effecting tissue recovery is doomed to failure if the prosthodontist merely says he is going to take the patient's dentures. Instead, after pointing out the abnormal conditions, the prosthodontist should explain that the soft tissues must be treated. This treatment is to consist of modification of the present dentures by the prosthodontist and certain home treatment and care by the patient.

The success of obtaining tissue recovery depends upon the patient's cooperation, and the patient's cooperation is influenced by the prosthodontist's convictions as to the importance of the procedure.

TREATMENT PLANS

In order to present a treatment plan for tissue recovery properly, the prosthodontist must consider the patient as an individual, and take into account his

mental attitude, temperament, and social and business obligations. Each treatment plan must be suited to the individual, so modification and compromises are necessary. The following outline of a treatment plan is recommended when the soft tissues are grossly deformed and traumatized, and the patient is unable to be without the denture for the time required for tissue recovery.

First, diagnose and institute treatment plans for correction of any systemic diseases (in cooperation with a physician, if necessary).

Second, diagnose and eliminate or minimize mechanical factors causing abuse. This includes the following six steps:

1. Correcting faulty occlusion and other denture defects causing instability and trauma.
2. Correcting the impression surface of the denture. This can be accomplished by locating and relieving all areas causing excessive pressure and deformation (Figs. 15 and 16).
3. In some extreme cases, placing a temporary relining in the dentures after they have been left out overnight (Fig. 17). This will improve stability and help control soft tissue form. It is necessary to remove the relining material and repeat the procedure every few days.
4. Minimizing or eliminating stresses by a soft diet and removal of the dentures at night.
5. Instructing the patient to stimulate the soft tissues by massage.
6. Leaving the dentures out of the mouth forty-eight to seventy-two hours prior to making an impression.

These six steps will help bring abused soft tissues of the denture-supporting area back to health and a more normal form (Fig. 18). The procedure will be recognized by the patient as a true health service.

DISCUSSION

It is well to remember that in the search for satisfactory complete dentures, we seek dentures that look well, that are comfortable to the patient, and that have stability, adequate retention, and proper occlusion at the time of delivery. These same qualities should be evident when dentures are replaced after they have been out of the mouth for a reasonable time.

Dentures may be removed to rest the supporting tissues overnight, or for a longer period. Regardless of the reason the dentures are removed, it should not be necessary to depend on time and the gross displacement of soft tissues to restore stability, retention, and acceptable occlusion. These qualities should be assured whenever the dentures are replaced. Further explanation of this concept can best be accomplished by reference to a specific case.

A patient, aged 22, who had been wearing complete dentures for two years, desired to have a broken lateral incisor replaced. The dentures (Fig. 19) were functioning satisfactorily, had adequate stability, and appeared to have acceptable occlusal relationships.

The abuse to the soft tissues of the denture-supporting area was recognized (Fig. 20). The traumatized, deformed condition of these tissues was pointed out

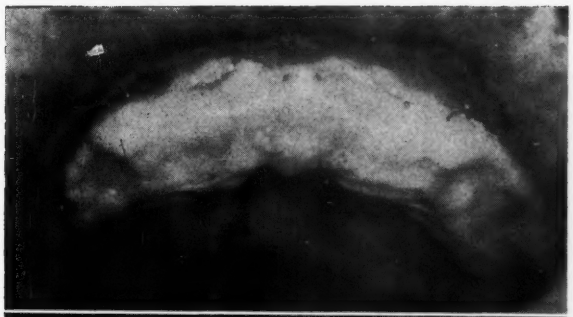


Fig. 15.

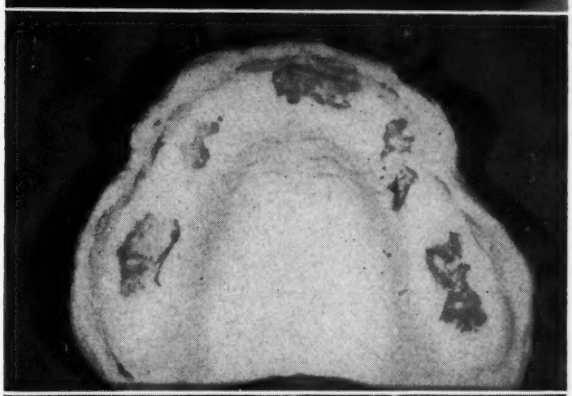


Fig. 16.

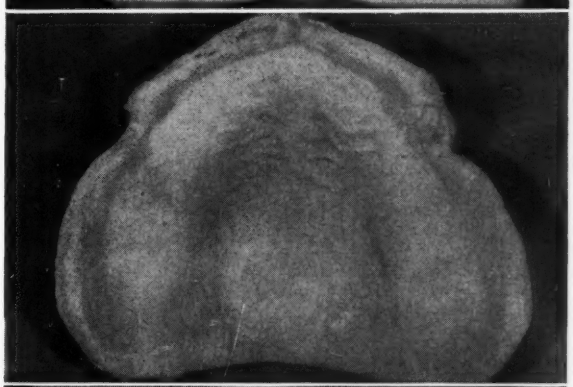


Fig. 17.

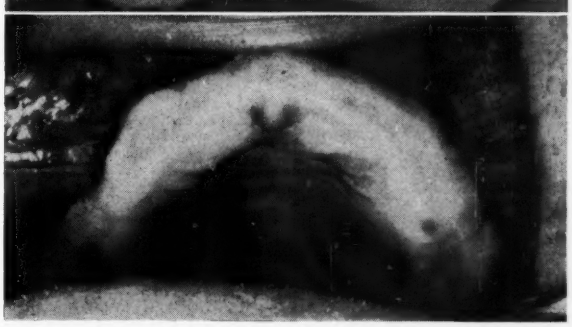


Fig. 18.

Fig. 15.—A maxillary arch with traumatized and deformed soft tissues.

Fig. 16.—The areas that caused excessive pressure and deformation of the soft tissues were located with a soft disclosing paste after the ill-fitting denture had been left out of the mouth overnight.

Fig. 17.—The impression surface of the maxillary denture seen in Fig. 16. The areas of the denture base causing excessive pressures have been corrected and a temporary relining has been placed to improve stability.

Fig. 18.—The maxillary arch seen in Fig. 15 after treatment. The soft tissues have improved in tone and are in a more normal form. An impression may now be made for a new denture.

Fig. 19.

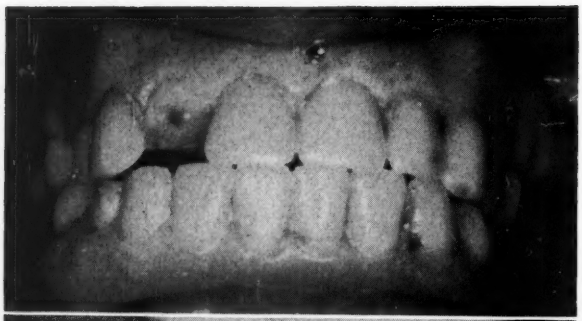


Fig. 20.

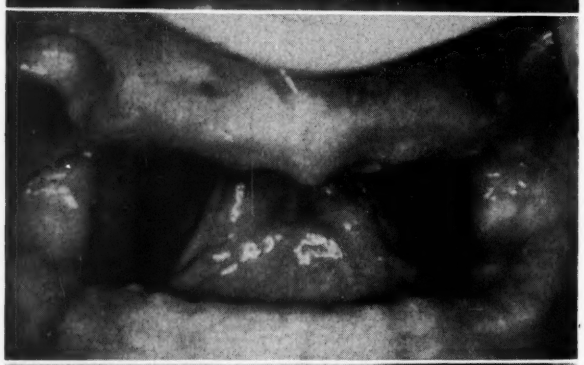


Fig. 21.

Fig. 22.

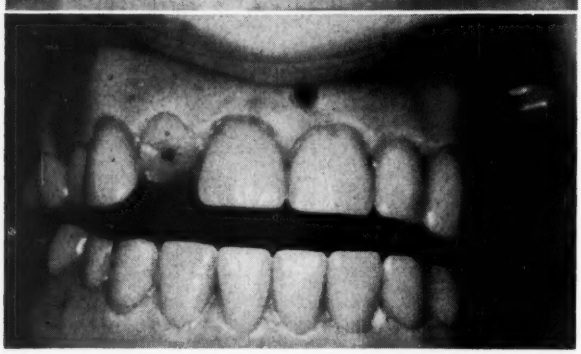


Fig. 19.—Complete dentures that had been worn for two years by a 22-year-old patient.

Fig. 20.—The abused and deformed soft tissues beneath the dentures in Fig. 19.

Fig. 21.—The recovered soft tissues after the dentures were left out of the mouth for 72 hours. Note the improved tone and the more normal form of the tissues as compared with Fig. 20.

Fig. 22.—Gross changes in the occlusal relationship were noticed when the dentures were replaced on recovered soft tissues. Compare with Fig. 19.

to the patient with the aid of the hand mirror and study casts. The patient readily agreed to proceed with a treatment plan for tissue recovery.

The treatment plan consisted of leaving the dentures out of the mouth from Friday night until Monday morning, and periodic massage to stimulate the soft tissues. The latter also made the patient aware that he was participating in the treatment.

An improved tone as well as change in form of the soft tissues was evident when the patient was examined on Monday (Fig. 21). When the dentures were replaced, gross changes in the occlusal relations were noted when the patient closed in centric relation (Fig. 22). The change in occlusion, the loss of retention and stability, plus the visual evidence of the improvement in tone of the soft tissues convinced the patient that the dentures were ill-fitting, and he requested that new ones be made.

Fig. 23.

Fig. 24.

Fig. 23.—The second dentures upon insertion.

Fig. 24.—The second dentures in place after tissue recovery. The patient had worn these dentures for 15 months. Note the occlusal relationship when they were replaced after having been out of the mouth for 72 hours. When compared with Fig. 23, we see no gross changes such as were seen with the first dentures (Figs. 19 and 22).

It is evident that these gross occlusal discrepancies had been concealed because of the ability of the soft tissues to adjust to the situation, and that the retention and stability apparent when the patient was first examined existed at the expense of the health of the soft tissues. It can be seen that leaving the dentures out of the mouth was necessary to evaluate the fit of the complete dentures.

New dentures were constructed. Special attention was paid to the recovery and management of the soft tissues throughout the construction of the new dentures (Fig. 23).

A routine examination of the second dentures fifteen months later revealed no evidence of gross deformation of the soft tissues such as was seen when the

Fig. 25.

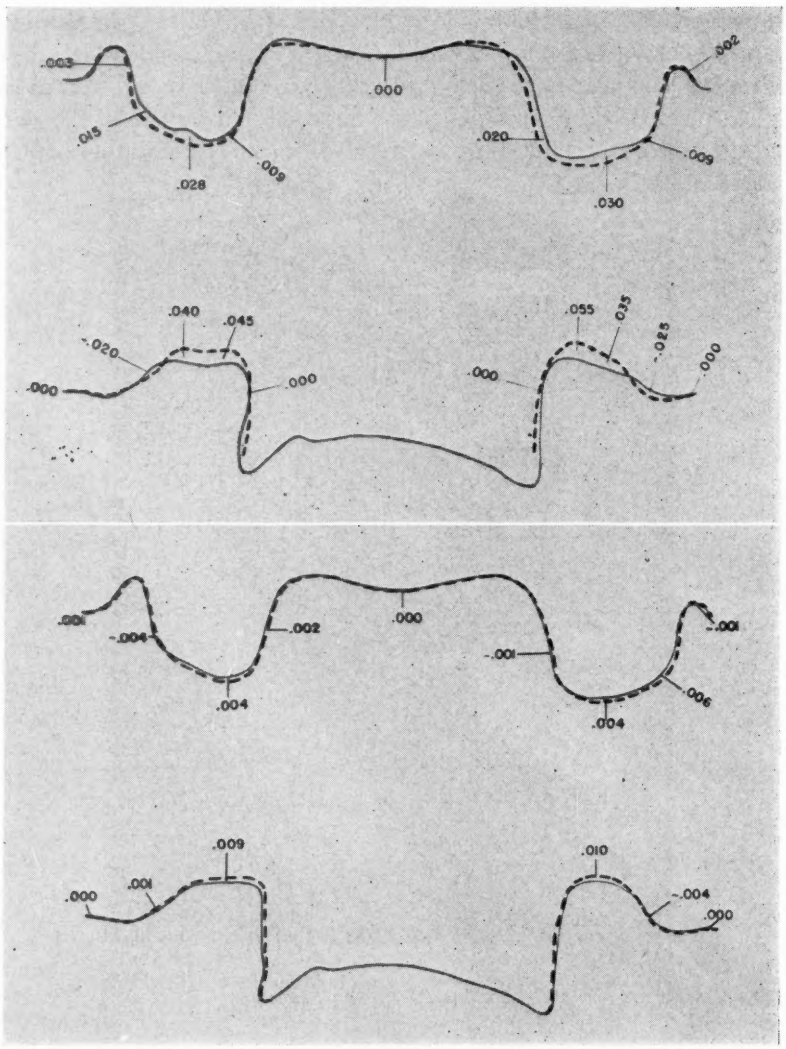


Fig. 26.

Fig. 25.—Cross section through the first molar region.* *Solid line,* The contour of the casts from impressions made when the tissues were in the abused, deformed condition seen in Fig. 20. *Broken line,* The contour of the casts from impressions made when the tissues had recovered. The ill-fitting dentures had been out of the mouth for 72 hours (Fig. 21). Note the difference as indicated in thousandths of an inch.

Fig. 26.—Cross section of the first molar region.* *Broken line,* The same casts illustrated by the broken line in Fig. 25. *Solid line,* The contour of casts from impressions made before tissue recovery after the patient had worn the new dentures for 15 months.

*Measurements were made at the National Bureau of Standards by CDR. N. W. Rupp.

patient had worn the first dentures. The patient cooperated in the examination by leaving the dentures out of his mouth from Friday night until Monday morning so that the magnitude of soft tissue deformation could be ascertained. When the second dentures were replaced, there were no gross occlusal changes such as had occurred during an equal period without the first dentures (Fig. 24).

Cephalometric roentgenograms made before and after tissue recovery show only minor changes in the position of the dentures in relation to the bony landmarks. Comparative measurements of casts and studies of intraoral roentgenograms revealed only slight changes in the form of the soft tissues when the dentures were removed for observation of the tissues.

From the foregoing observations we may draw this conclusion: After more than fifteen months, this patient may leave the second dentures out of his mouth for a reasonable period; and when they are replaced, they are comfortable, stable, have adequate retention, and are free of gross occlusal discrepancies. This seems to indicate that the dentures are compatible with the supporting structures. It is doubtful that the outcome would have been as favorable if the dentures had been constructed on casts made from impressions of the abused tissues (see Fig. 20) and gross deformities of these tissues had been perpetuated.

The first dentures caused gross deformation of the soft tissues of the denture-supporting area. A change in the contour as great as 0.055 inch was evident when casts made from impressions before and after tissue recovery were compared (Fig. 25).

The contour of casts from impressions made after the patient had worn the second dentures for fifteen months compared favorably with casts made before the new dentures were constructed. The maximum difference was 0.010 inch (Fig. 26). This is another indication that the second dentures are relatively compatible with the supporting structures.

Another very interesting observation was made in this case. The patient exchanged the new dentures for the old, ill-fitting dentures that he had not worn for fifteen months so that further records could be obtained. At the time the ill-fitting dentures were placed in the mouth the tissues had excellent tone, the contours of the ridges were similar to those seen in Fig. 21, and the occlusal relationship was similar to that seen in Fig. 22.

After the patient had worn the ill-fitting dentures for five days, they again had adequate retention and stability, there were no gross occlusal discrepancies, and occlusal relationship was similar to that seen in Fig. 19. The soft tissues beneath the dentures were again abused and deformed to the condition seen in Fig. 20. The patient stated the dentures were no longer uncomfortable; however, he noted a tingling sensation over the ridges immediately after the dentures were removed.

No change in the condyle-fossa relationship could be demonstrated with laminagraphic studies. The change in occlusion and the return of retention and stability seemed to be at the expense of the health of the soft tissues of the denture-supporting area. The ill-fitting dentures were removed and the second dentures returned to the patient.

CONCLUSION

We cannot overlook the effect that the soft tissues of the denture-supporting area have on the success of complete dentures. These tissues must be considered from the time the patient first appears for diagnosis until the final adjustment is made. Even after this we must be interested in their health if the ridges are to be preserved and the dentures are to function satisfactorily.

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A SURGICAL APPROACH TO IMMEDIATE DENTURE ESTHETICS

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Philadelphia, Pa.

THE purpose of this article is to suggest a technique which simplifies the surgical procedure in immediate denture insertion which permits the esthetic arrangement of the teeth, and the placement of the denture base with a labial flange with ease.

The construction of an immediate denture presents problems in esthetics and in seating of the denture, especially if a labial flange is used on the denture. The solution of these problems has been attempted in various ways. Dean's intraseptal alveolotomy, as described by Sinfield,[1] aimed at retaining the labial plate of bone by sacrificing the interalveolar septum and fracturing the labial plate to bring it into contact with the lingual plate of bone. The space for the labial flange of the denture was effected in this manner, and the teeth could be placed in an esthetic position. Keyworth[2] realized the same end by removing the labial plate of bone. He accomplished this by raising a flap extending from the distal of the cuspid to the distal of the other cuspid, and removing the bone from the "center of the socket at the gingiva and up two-thirds the distance to the labial attachment." In these and other similar techniques, the labial gum tissue was retained as a flap, and bone was sacrificed to permit the flap to cover the remaining bone. In principle, these techniques are examples of virtually all of the techniques that have been described in the literature about surgery for immediate dentures.

Patients requiring immediate dentures are in one of two esthetic classes, both of which have essentially the same surgical problem. The difference is only one of degree. The first class is a true maxillary protrusion which is to be modified to such extent that the actual tooth position becomes altered, thereby reducing the protrusion. The second class is one in which the denture should avoid changing the over-all facial contour and expression. In the second class, a protrusion of the lip is a problem only immediately after the extraction of the anterior teeth when an immediate denture is inserted. If the patient in this class is allowed to remain edentulous for a period of time, the fullness of the lip would reduce itself during the normal process of healing. The problems in the second class consist of replacing the patient's dentition as accurately as possible, incorporating minor changes, such as reducing a lingual or labial version, correcting a rotation, reducing or eliminating an interproximal space or diastema, or alleviating crowding, etc. The positions of the teeth and the lip should appear to be the same, with the immediate denture in position, as they did before it was inserted.

In both classes the problem concerns the handling of the cervical ends of the teeth and that portion of the tissues which hinder the placement of the teeth, or

Received for publication Jan. 26, 1956.

the seating of the denture in such a way that an esthetic result may be obtained. The technique to be described differs from other techniques in that (1) the soft tissues are excised before any bone is removed and (2) no attempt is made to cover any bone which is cut or exposed (Fig. 1). No flap of soft tissue is retained, and this permits the retention of more bone since additional space has been

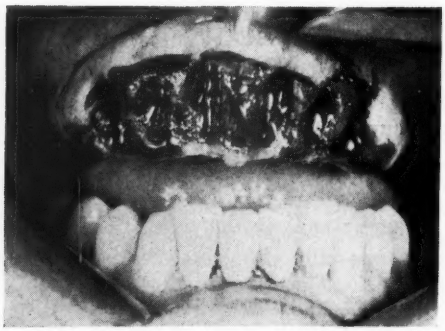

Fig. 1.—The soft tissues are excised, and no attempt is made to cover the exposed bone.

Fig. 2.

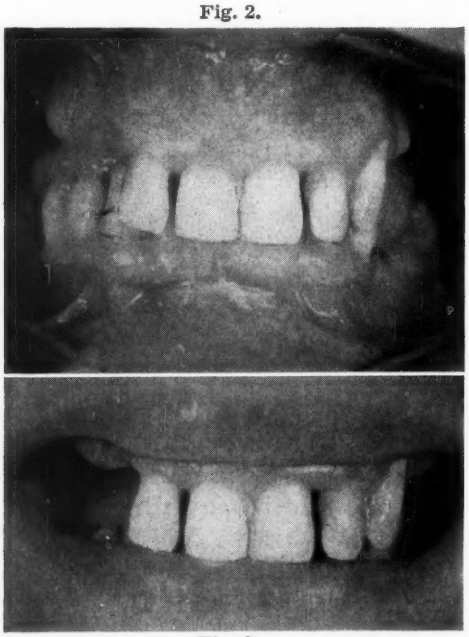

Fig. 3.

Fig. 2.—The teeth are examined to determine changes in tooth position and arrangement which would improve their appearance.

Fig. 3.—The relation of the incisal edges to the lip are observed.

created by elimination of the flap. The retention of the maximum bony support is important to the future success of the denture-bearing areas. In most instances when the tissues are removed in this fashion, bone is either exposed or removed, or both. In effect, an adapted type of periodontal surgery[3, 4] has been performed for

an edentulous mouth. An architecture is created which permits the insertion of an esthetic immediate denture with a labial flange, and this is conducive to the future health of the denture-bearing ridge. Healing postoperative care and complaints follow the same general pattern as those which follow periodontal surgery, and the denture acts as the protective covering. Bone[5, 6] exposed in the surgical procedures heals rapidly and uneventfully. The denture remains stable for a longer period of time because the minimum amount of bone supporting the denture base has been

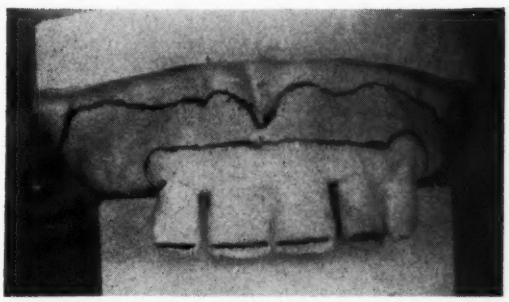

Fig. 4.—The cast is marked to the height of tissue interference and the high lip line.

Fig. 5.

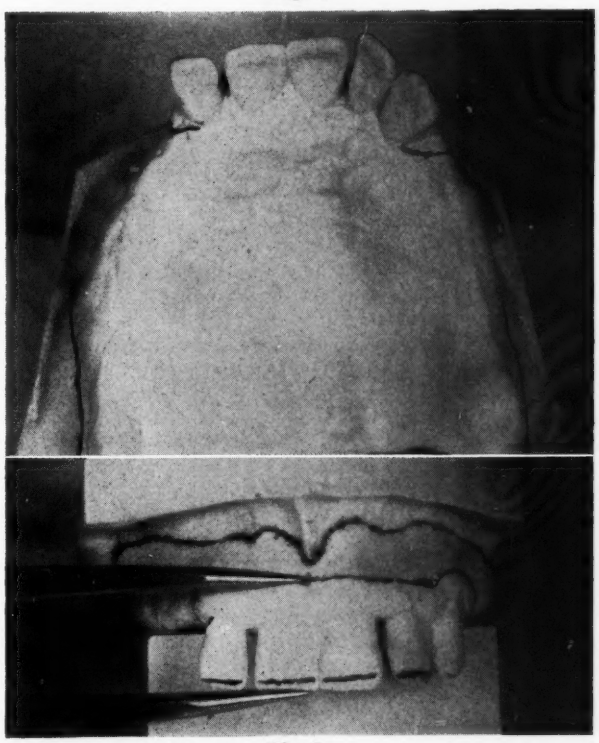

Fig. 6.

Fig. 5.—The labial line is continued to the gingival margin on the lingual side.
Fig. 6.—Calipers are used to transfer the reference lines to the study cast.

removed. The granulation tissue which forms partially compensates for the shrinkage which normally occurs after the removal of teeth.

THE TECHNIQUE

When the final impressions have been made, the working cast and a final study cast poured, the patient and the mounted casts are studied with a view toward

Fig. 7.

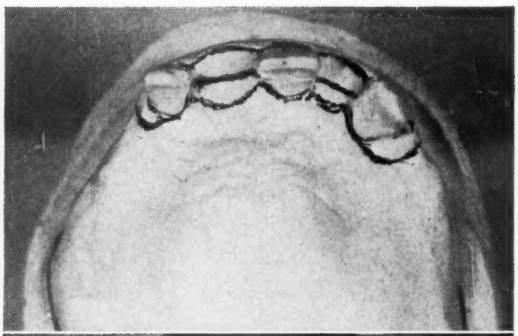

Fig. 8.

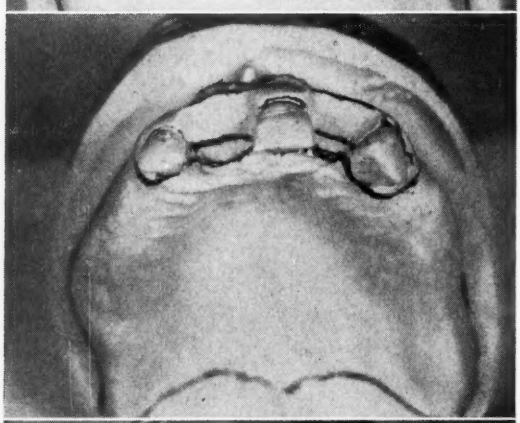

Fig. 9.

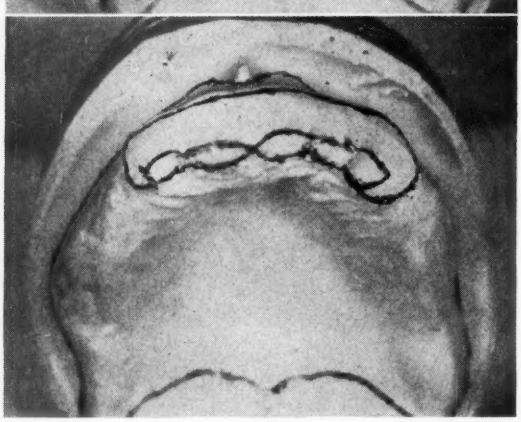

Fig. 7.—Each socket is bisected from mesial to distal.
Fig. 8.—The cast is trimmed from the center of the socket to the labial line.
Fig. 9.—The trimming is completed.

determining what changes are desirable in tooth position and arrangement (Figs. 2 and 3). If the upper teeth protrude, a determination is made of how much reduction will be needed. The presence of undercuts will be noted to determine whether they will interfere with the seating of the denture. An attempt is made to determine what effect the labial flange of the denture will have on the position of the lip and the facial contours. This effect can be predicted by placing thin layers of gauze or cotton under the lip, thereby assisting in the visualization of the potential changes.

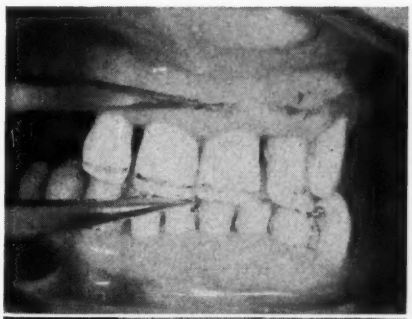

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 10.—The line to which trimming is intended is marked by a series of punctures with sterile calipers.

Fig. 11.—The tissues from midpoint of the socket to the labial line are excised.

Fig. 12.—No flap of soft tissue is retained.

Next, attention is directed to tissues which will hinder tooth positioning or denture placement. These tissues are the free margin of the gum, the interdental papillae, the attached gingivae, the frenum, and a varying portion of the underlying

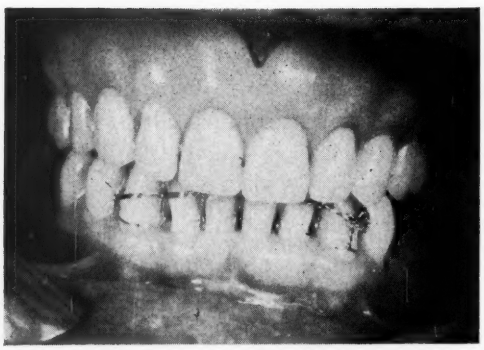

Fig. 13.—The immediate denture is seated easily.

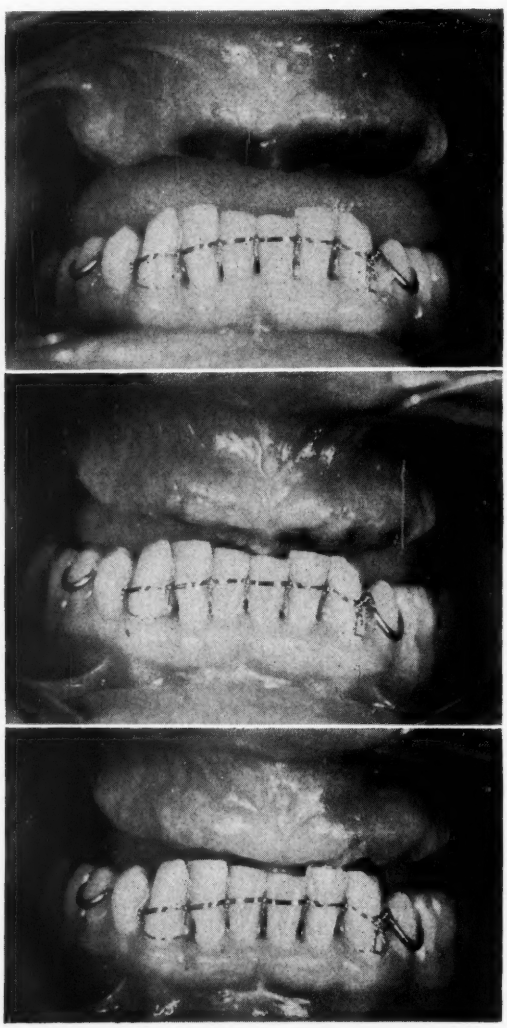

Fig. 14.—*A*, The appearance of the mouth twenty-four hours postoperative; *B*, seventy-two hours postoperative; *C*, ten days postoperative.

bone. After careful evaluation, a line is marked on the cast to indicate the height of tissue interference (Fig. 4). An interfering frenum is simply removed from the cast to the height desired. Tooth shades are carefully selected and the laboratory procedures are carried out.

LABORATORY PROCEDURES

The line on the working cast, indicating the height of tissue interference, is continued around the teeth to end at the lingual gingival margin (Fig. 5), allowing the margin of the proximal gum tissue to extend beyond the line. This entire line is carefully duplicated on the study cast by means of calipers (Fig. 6). The stone teeth are carefully removed from the stone cast.

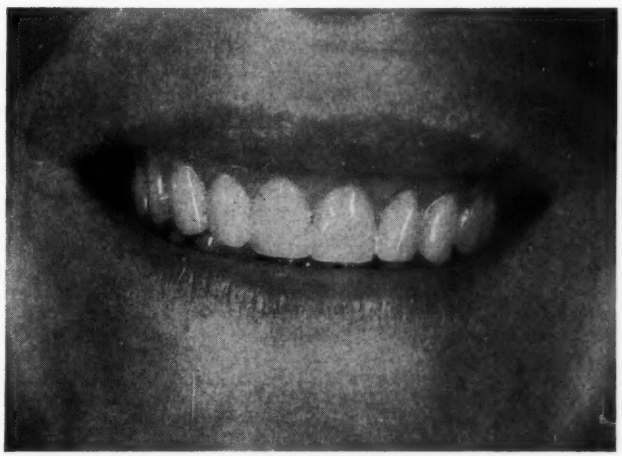

Fig. 15.—The completed restoration.

Three methods are used in setting artificial teeth: (1) Each alternate stone tooth is removed from the cast, and the artificial replacement is waxed into position, then the remaining stone teeth are removed from the cast, and the set-up is completed. (2) Three anterior teeth of one side are removed from the cast and replaced and waxed in position, then the remaining three anterior teeth are removed and replaced with their artificial substitutes. (3) All teeth are removed and replaced by their artificial replacements and waxed in position. As each tooth is cut off the cast, a line is drawn from the mesial to the distal so it bisects the socket (Fig. 7). The cast is then trimmed to the line on the labial side (Figs. 8 and 9). When the teeth are set, the occlusion is checked, and the denture is completed.

SEATING THE DENTURE

The patient is anesthetized. The line on the labial surface of the cast, to which trimming is intended, is reproduced in the mouth by means of a series of punctures with sterile calipers (Fig. 10). The teeth are removed and a ronguer or a heavy gum scissor is used to remove the marked tissues to the midpoint of each socket (Fig. 11). Sharp edges of bone are removed either with coarse

diamond stones or a bone file. No flap is made, and whatever tissues fall between the lines as described are removed in toto (Fig. 12). An interfering frenum may be either thin and narrow or heavy and broad. The former is simply snipped, and the denture acts as a stent. The latter is cut at the desired height after being grasped with a hemostat, then the tissue wedge to be excised is cut with the scissor flush against the labial gum. The denture will seat easily (Fig. 13). The patient is cautioned not to remove the denture until his return to the office in twenty-four hours. Postoperative sequelae are minimal, and the final healing is rapid and ends in a firm ridge (Fig. 14). The retention and stability of the denture remain good, and the esthetics are as planned (Fig. 15).

SUMMARY

The problems in esthetics and in seating an immediate denture with a labial flange have been discussed. A surgical technique for immediate dentures has been described. The tissues which prevent the seating of the denture or the esthetic placement of the artificial teeth are excised. The soft tissues are removed before the bone is cut away. No flap of soft tissue is made or retained. The denture is seated easily, and the desired esthetic result is obtained.

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LOWER CAST METAL BASE DENTURE

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IMPRESSION MATERIALS RESOLVE themselves into two main types: (1) Those with low amount of flow (body high), and (2) those with high amount of flow (body low). The first is excellent for correct border placement, but is deficient in recording tissue detail and tends to displace tissue unevenly, unless it is used at the ultimate centric relation and vertical dimension relationships. The second type can reproduce tissue detail well, but is difficult to handle around the borders, due to its high flow tendencies.

An impression material should display four attributes: (1) it should record tissue detail, (2) it should not displace tissue, (3) it should have sufficient body to facilitate border placement, and (4) it should be correctible. Of course, other qualities (freedom from dimensional change, compatibility with the tissues, among others) should not be disregarded, but only the four named above will be important to this article. The use of two impression materials, combined in order to satisfy the four desired attributes, will be described.

OBJECTIVES OF COMPLETE DENTURE SERVICE

The objectives of complete denture prosthesis are: (1) stable and retentive bases; (2) physiologic stimulation of, and compatibility with, the tissues by the denture bases; (3) duplication of tissue detail by the impression; (4) accurate border placement of the denture bases; (5) pleasing esthetics; (6) true centric relation and vertical dimension relationships (to make for good function); (7) minimal tissue changes beneath the denture bases; (8) processing accuracy (freedom from warpage) during the laboratory phase of construction; and (9) a minimal adjustment and postinsertion phase of denture service, for the mutual satisfaction of the patient and the dentist.

Acrylic resin denture bases display warpage during processing and after being placed in service. Skinner[1] states, "The results of our research are definitely in agreement with those of Worner that the dimensional accuracy of the modern acrylic resins is not as good as that exhibited by the vulcanite of past years." Peyton[2] states, "In general, it is established that all resins receive some internal strain during processing, which may be released, as warpage, when placed in service." To overcome these defects, I wanted to use a cast metal base, particularly for a lower denture. But, overextension and the subsequent difficulty in adjusting metal borders properly were problems that had to be solved. The following technique was evolved to utilize a cast metal base and still provide for accurate border placement.

Received for publication May 11, 1956.

TECHNIQUE

This lower denture technique makes use of two different impression materials.

At the initial visit, following the history-taking and examination, an alginate impression is made. This impression should locate the borders as accurately as possible with the alginate material. If indicated, an individual tray should be made, and the alginate impression made at a second appointment. The cast is poured and prepared for the fabrication of the metal base (Fig. 1). The metal base is cast 3 to 4 mm. short of the borders. The metal base should not impinge upon the soft tissues during the functional movements of the mandible (Fig. 2).

At the next appointment, the metal base is inserted and checked for extension and stability. In no case should the metal base engage a tissue undercut. Extension of the lingual flange beneath the internal oblique ridge will result in soreness. Extension beneath undercuts on the buccal or labial surfaces will result in soreness. If the metal base has been cast accurately, a surprising amount of retention will be displayed at this time, even though the base is short of the ultimate denture borders.

Fig. 1.

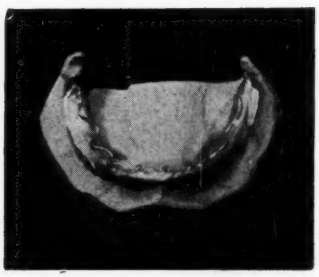

Fig. 2.

Fig. 1.—A cast made from an alginate impression with a pencil line showing the limit of the metal base.

Fig. 2.—The metal base in place on the cast.

An occlusion rim of baseplate wax is built up on the metal base and extended 2 to 3 mm. beyond the borders of the metal base. Centric relation and vertical dimension registrations are made. The casts are mounted on the articulator and the teeth are set up.

At the next appointment, the centric relation, vertical dimension, and esthetics are checked in the patient's mouth. The lower wax base *with the metal casting in place* is checked for proper extension. No movement of the base should be apparent when the patient exercises functional mandibular motions. If movement occurs, a sharp knife or scissor is used to shorten the wax where indicated. If the wax base is underextended, baseplate wax may be added in the areas where it is needed.

A sharp instrument is used to remove sufficient baseplate wax to make space for an adequate layer of Kerr Korecta-Wax No. 4. The wax denture on the metal base is inserted, and the Korecta-Wax is allowed to reach body temperature. Functional movements are performed by the patient. It is best to trim the buccal borders with an open mouth technique, and the lingual borders in centric occlusion and with the swallowing mechanism. The wax denture is removed and inspected.

Any encroachment of the wax on the metal is removed with a sharp instrument. If needed, more wax is added, and the procedure is repeated until the wax shows a uniformly smooth and shiny surface. Intimate tissue contact has then been established. A final insertion for five minutes is made, and the wax is chilled by having the patient rinse the mouth with cold water. Then the trial base is removed quickly (Fig. 3). The cast is poured directly into the refined wax and metal base. The usual laboratory steps are taken for finishing the denture. Care must be taken in polishing the borders to avoid changes in the borders.

Fig. 3.—The final impression of the borders in wax, and the ridge in metal. Note the final impression of the borders is made after the teeth have been arranged in occlusion.

ADVANTAGES OF THE CAST METAL BASE

1. The metal base prevents acrylic resin warpage during processing.
2. The metal base is stronger than acrylic resin and is subject to less breakage.
3. The metal base is more accurate than acrylic resin and tissue detail is reproduced more faithfully.
4. Less tissue change will occur beneath a metal base.
5. A metal base is less porous than other materials. Porosity leads to bacterial fermentation. Fermentation, along with the low thermal conductivity of other base materials, is a contributory factor to ridge resorption.
6. Metal is a better thermal conductor than acrylic resin.
7. Dentures with metal bases show much less lateral deformation in function. Regli and Kydd[3] have shown the metal base denture to be eight and one-half times more resistant to lateral deformation in function than the plastic base denture. It is also their belief that the deformation in the plastic base denture for the case studied may have contributed materially to the atrophy of the alveolar ridge.

ADVANTAGES OF THE TECHNIQUE

1. An accurate impression of the stress-bearing tissues is made with a minimum of displacement. This accuracy is maintained by the metal base.
2. The borders are placed accurately. All other factors being equal, adjustments are minimal. These factors are the centric and vertical relationships, and the elimination of occlusal disharmonies which may occur during processing.

3. Patients apparently learn to use the dentures more quickly than with other procedures.

4. The "ridgeless" problem case has been met much more successfully.

5. There is a "snugness" of fit with the metal base which seems to be absent in an acrylic resin base denture.

DISADVANTAGES OF THE TECHNIQUE

1. The cost of the denture is greater than that of one with a plastic base.

2. Refitting of the denture is difficult.

3. The technique is more time-consuming than those for making plastic base dentures. However, due to the uniformity and excellence of results, the advantages seem to outweigh the disadvantages.

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BLOOD CHEMISTRY—A DIAGNOSTIC AID IN DENTURE PROSTHESIS*

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A FEW ADDITIONAL MINUTES added to the time one allows for diagnosis may save hours of time, and wear and tear on one's nervous system. Occasionally we have patients presenting the problems of rapid alveolar resorption, chronic sore mouth under dentures, hypersensitivity of teeth supporting clasps or attachments, and others, any one of which can change what should have been a pleasant doctor-patient relationship to one of dismay and unhappiness on both sides.

The fault is not entirely due to the patient. The dentist may be to a lesser degree to blame in that his diagnosis was limited to the mouth conditions only. After the prosthetic appliance is completed, he finds to his dismay the patient returning day after day, week after week, ad infinitum. "They're too loose!" "I'm in agony all the time." "They just don't fit." "I can't wear them, they make my mouth too sore." These are a few of the stock phrases. Relines, adjustments, remakes, are to no avail. The end result is a very miserable patient and a hypertensive, ulcerative dentist.

To a great extent, all of this could have been avoided and the outcome predicted. One cannot reasonably expect an artificial appliance, when placed in a mouth which is still part of a complaint-wracked body, to be successful in all cases. Patients informed before receiving their dentures are, in most cases, understanding ones.

OBTAINING SUBJECTIVE HISTORY

One of the most important questions we ask the patient is whether or not he or she is being attended by a physician and, if so, what injections, hormones, or oral drugs are being given. This information should be obtained from the attending physician and noted.

Various compounds of cortisone can produce painful lesions in the mouth with subsequent inflammation and pus-producing areas. Restorative appliances are very often presumed the cause of these areas when such is not the case. Eliminating the cortisone for a few days will establish whether or not it is the causative factor. Better still, if a blood chemistry is taken while the patient is

Read before the Pacific Coast Society of Prosthodontists, Phoenix, Ariz., March 30, 1956.
Received for publication May 7, 1956.
*This article was commissiond by the Editorial Council of the Journal of Prosthetic Dentistry upon the suggestion of the Program Chairman of the Pacific Coast Society of Prosthodontists.

taking cortisone, then repeated in three or four days following the discontinuance of cortisone, a comparison of the two blood chemistries will establish whether any "side" effects are occurring in the mouth. In the event one can establish the existence of so-called side effects, the physician should be consulted again as to the feasibility of drastically reducing the size of the dosage being administered. Of course, tact is a virtue in this instance.

An excess of thyroid substance and its derivatives (proloid thyroxin, and so forth) will likewise create a hazardous mouth condition in some patients. These excesses are frequently manifested in rapid alveolar and ridge resorption, red inflamed mucosa and nasal septum, and a low tissue tolerance to prosthetic appliances. Most of these patients present a very typical picture. They are very talkative and nervous. When we pry into the reason for their taking thyroid in doses ranging from 0.5 grain to 10 grains, the answer is a low basal metabolism, tendency toward overweight, and chronic fatigue. Here again we can use the biochemical index to determine scientifically the efficacy of this hormone in this patient. From a dental point of view, we have found that, with but very few exceptions, the amount of these substances the patient is taking is too great. In most instances, by adding pituitary substance to the patient's regime a much more desirable dental condition is obtained. Large doses of thyroid (3 to 5 grains or more) have been termed as replacement therapy and continued usage of these large amounts over a period of years can, and frequently does, produce atrophy of the thyroid gland. If nothing can be done to correct this condition, the patient should be forewarned as to the probable hazards she may experience with any type of restorative appliance. Too many men are trying to assume full responsibility in these cases by assuring the patient that the technique he will employ will be the keynote to success. By the very nature of things, any appliance, no matter how skillfully made, cannot correct the ills of the body. It is of paramount importance to evaluate a patient's physical, psychologic, and nutritional status *before* we get to the articulator stage of treatment.

Estrogen and its derivatives, Premarin, estradiol, among others, create their share of alveolar resorption, ridge loss, and hypersensitive tissues when used symptomatically to alleviate "hot flushes" in menopausal distress. If the oral conditions noted above can be considered as "side effects," it is readily apparent that in some cases constipation, headaches, and arthritic pains are likewise a result of overdosage. It is amazing, sometimes, to see what effects a simple diet has on the individual after the complete withdrawal of these estrogenic compounds. Diet in itself is not going to be the whole answer and, many times, other endocrine substances may be used to help in this readjustment to a person's physical-dental well-being.

Any drug, and even vitamins, will affect the blood chemistry which in turn may create unfavorable conditions in the mouth. High potency vitamins can cause ulcerative lesions in the mouth which are very painful, especially to the touch. This obviates the possibility of wearing any tissue-born restoration. Just which one of the vitamin fractions or combination of fractions activate the lesions is not fully understood. Several cases of hypervitaminosis have been under observation. In order to establish whether or not vitamins are responsible, stop the intake of them.

If vitamins are the cause, these lesions will disappear in a matter of a few days. Have the patient take the vitamins again, and it soon can be established that they are the activating agent.

The continued use of any drug such as the derivatives of aspirin, the daily use of laxatives, magnesium compounds, and the so-called antacid drugs also lend to tissue intolerance and bone resorption. These drugs can give symptomatic relief only, yet may create tissue intolerance in the mouth.

To determine the subjective symptoms, the patient may be asked the following questions.

Do you have excessive dandruff? Ringing or buzzing in the ears? Loss of hearing? Night blindness? Acne? How frequently do you have a sore throat? How many colds do you have per year? Do you have a postnasal drip? Sneezing in the morning or during the day? Sinusitis? Coughing? Expectorating? Gagging? How frequently do you have headaches (occipital, temporal, frontal)? Are there abscessed teeth? How many? Are the tonsils present or removed?

Do you have trouble with constipation? Are you taking laxatives? What kind of laxatives? Do you have gas after eating, pain, or stomach distress? Loose bowels? Nervous stomach? Butterflies? Are your menses heavy or scanty and what is their duration?

Do you have urinary frequency? Burning sensation?

Do you have pain or stiffness in the fingers? Joints? Back? Neck? Do you have muscle cramps? Leg cramps at night? Chronic fatigue? Are you tired or exhausted upon awakening? Do you have shortness of breath on slight exertion? Do you have pain or heavy pressure in your chest? Are you troubled with sleeplessness? Are you nervous? How much coffee and alcohol do you drink? What surgical operations have you had?

What tensions, if any, exist at home, in the office, or in your business? Do you rub or grind your teeth? Do you bite your nails? Do you have a tic?

In addition to these questions you may observe the color of the mucous membranes of the mouth, pharynx, and the nasal septum (pale, normal, red), and the complexion of the face (pale, normal, ruddy).

AN EXAMPLE

When these questions have been submitted to the patient, we may have the following résumé:

The patient has been taking 4 grains of thyroid daily for the past four years, receiving estrogen injections once or twice weekly. She has daily occipital headaches, a pale complexion, a postnasal drip (sinusitis), sneezing in the morning. The mucous membranes and nasal septum are red. She has much gas after eating, chronic constipation, chronic fatigue, pain in the neck, back, and knees. She is nervous and irritable, and has urinary frequency—3 or 4 times nightly. This summary should put one on guard as to the improbable success of the restoration for the patient. It is one thing to fit the mouth, and an entirely different matter for the patient to fit the appliance.

With so many complaints as above, a urine and blood chemistry analysis should be made of the patient. The patient is referred to a serological laboratory with the following tests requested:

Biochemical Index.—

Urine—Ph; specific gravity; calcium precipitation; indican.

Blood—Blood pressure, temperature; calcium, phosphorus; hematocrit; percentage of hemoglobin and blood sugar. All blood samples should be taken under overnight fasting conditions.

Calcium-Phosphorus Ratio.—

There is quite a latitude of normals for each test given.[1] Normal for calcium is given at 9.0 to 11.5 mg. for 100 c.c. of blood. We find that the best clinical results are obtained when calcium is maintained at 9.5 to 10.5 mg. with 10.0 mg. being the optimum amount.[2] Phosphorus, also, has quite a wide range. The so-called normal being given at 2.5 to 4.0 mg. per 100 c.c. in most texts.[3] Dental clinical results require that a range of 0.5 mg. is all that phosphorus should be allowed to fluctuate, for example, 3.2 to 3.7 mg. per 100 c.c. of blood, with 3.5 mg. being optimum.

This is in contradiction to Page[4] who establishes 4 mg. as the optimal amount of phosphorus. I am at a loss to explain the lower figure. Perhaps a safer rule would be to establish a ratio of 2½ or 3 times the amount of calcium to 1 of phosphorus. Clinical results are obtained when this ratio is established, when drugs, vitamins, or endocrine substances are used *in conjunction with a sugar free diet.*

The amount of calcium or phosphorus in the blood apparently is in inverse proportion to the amount ingested from foods, such as milk, cheese, and so forth. Oddly enough, the higher calcium values seem to indicate the greater need for calcium in many cases.

To illustrate: A young man was treated by me because of excessive dental caries. From three to five cavities would appear every four months, and teeth which had already been filled would decay. For a period of nine months during treatment no new cavities appeared. The Ca-P index remained rather constant—10.2 of calcium to 3.5 of phosphorus, with slight fluctuations. Treatment consisted of thyroid and posterior pituitary extract, plus a diet. After this time he went away to college. Seven or eight months later new cavities began to appear. A blood chemistry was taken and everything was within normal limits excepting calcium, which was low—7.8 mg. I suspected that he was not adhering to his diet but he insisted that he had. Upon further questioning, I learned that he was drinking two to three quarts of milk daily. When this was restricted to one quart daily, the blood calcium rose to the optimum figure of 10 mg. Six months later no new cavities had developed. These results were based upon one chief factor—that the patient had adhered to the diet.

Erythrocyte Sedimentation Rate.—

The erythrocyte sedimentation rate is another very important test to make when evaluating a patient. To determine this rate, citrated blood is placed in a

graduated tube, and the rate of settling of the red cells in one hour is noted in terms of millimeters. It is like allowing muddy water to set for one hour, and measuring the clear water on top. There is quite a variance in this rate in each individual. The phenomenon of the rate of settling of the erythrocytes is not fully understood. Yet, a higher rate (45 mm. more or less for example) is usually associated with some severe organic disturbance, such as rheumatoid arthritis, coronary or precoronary disturbances, chronic or acute infections (tuberculosis, pneumonia), malignancies, pregnancy, rapid alveolar resorption, rampant caries, and chronic alcoholism. I emphasize that not all persons with rapid alveolar resorption, hypersensitive tissues, and so on, will fall into this category. Infrequently, a sedimentation rate below the optimum of 10 mm. is likewise indicative of mouth disturbances. Where the sedimentation rate is above 30 mm. or below 6 mm. this should be one of concern to the dentist, because of its relationship to calcium, phosphorus, hemoglobin, and blood sugar.

It has been my observation that chronic abscessed teeth generally do not cause an increased rate of sedimentation; that is, in patients where arthritis is not associated with the abscessed teeth.

Hematocrit or Cell Volume.—

Citrated blood is placed into a graduated tube and centrifuged for one-half hour. A reading is made of the packed cells from the bottom of the tube up, in terms of cubic centimeters or millimeters, depending upon the technique used. The reading, when multiplied by 100,000 gives a fairly accurate red cell count. For example: 45 mm. $\times$ 100,000 = 4,500,000 red cells. This result was checked on ten different blood samples with the usual technique of counting red cells. Three separate counts were made of each of the ten samples and the average taken. It was found that an error of 50,000 plus or minus occurred in the packed cell method of multiplying by 100,000 as when checked against the microscopic method of counting red cells. Strangely enough, by dividing the hematocrit reading by 3, the resulting number can be interpreted fairly accurately in terms of milligrams of iron per 100 c.c. of blood.

The optimum hematocrit reading for this work is 42 for the female, and at least 45 for the male. In higher altitudes, these figures would rise appreciably and they would be lowered in tropical climates.

Again, the hematocrit reading may be multiplied by 2 and the per cent of hemoglobin can be established rather precisely. For example: The hematocrit reading $45 \times 2 = 90$, the percentage of hemoglobin.

Mistakes can occur when the red cell count and the per cent of hemoglobin are done in a commercial laboratory. By dividing the per cent of hemoglobin by 2 and multiplying the result by 100,000 one can easily check as to the relative accuracy of the red cell count.

Blood Sugar or Glucose.—

Textbooks vary as to the norms for glucose, and there is quite a latitude. "Normal" has a spread of from 80 mg. to as high as 120 mg. per 100 c.c. Any reading below 80 mg. is termed as hypoglycemia and a reading above 125 mg. is termed

as hyperglycemia. Acute or chronic infections such as peridontitis with profuse discharging of pus will frequently be found to be hyperglycemic.

It is rare to find a dental patient with hypoglycemia—below 80 mg. per 100 c.c. But in case a patient has a low blood sugar, do not prescribe sugar, candy, and desserts. The elimination of sugar, plus a high protein diet is indicated. In most cases, this will bring the blood sugar to its optimum level.

A young woman, age 19, was complaining of chronic fatigue. Upon the advice of her physician, she was instructed to eat four to six candy bars plus desserts daily because her blood sugar was 60 mg. After two weeks of this regime, her gums started to bleed profusely. Her blood sugar which had been 60 mg. per 100 c.c. had dropped to 50 mg. per 100 c.c. She complained of being more tired than ever. Omission of refined sugar foods and white flour products, plus a high protein diet was prescribed. Three weeks later, the blood sugar rose to 102 mg. and the gums healed uneventfully, and she was "feeling like herself again." Hyperinsulinism was probably the factor responsible for the condition in this case. The increased sugar intake simply aggravated the patient's symptoms by increasing the insulin secretion.

The value of obtaining a subjective history and a blood chemistry has been demonstrated many times. Infrequently, diabetes mellitus has been discovered in patients whose complaints were not typical of those suffering from early symptoms of diabetes. Yet sugar or glucose values have been found in ranges from 200 to 400 mg. per 100 c.c. These patients are very poor dental risks and should be under the care of a physician. It is not within our province to diagnose diabetes, but glucose values which remain high over a period of two or three weeks should be investigated by a physician.

SUMMATION OF LABORATORY FINDINGS

Now to return to the patient who has been taking thyroid-estrogen because of her many physical complaints, plus the fact that in twenty-two months five upper dentures had been constructed due to bone resorption, blood-urine examinations were made on the first visit with the following results.

TABLE I

FEMALE	TEMPERATURE	BLOOD PRESSURE	URINE			
			pH.	SP. GR.	CA PPT.	INDICAN
Optimum levels	97.6°	120–70	5.5	1.020	Slight	0
First visit	97.0°	105–70	7.0	1.010	Heavy	3
	BLOOD CHEMISTRY					
	SED.	CA	P	HEM.	HB.	B.S.
Optimum levels	1.5	10.0	3.5	4.2	85%	100
First visit	4.5	11.5	2.2	3.6	72%	135

From the basis of optimal levels, it will be noted that the blood pressure, urine specific gravity, phosphorus, hematocrit and hemoglobin are low, especially the phosphorus. The urinary pH, calcium precipitation, indican, sedimentation rate, calcium and blood sugar are much higher than desired.

The importance of this observation is the over-all picture; the relationship of one to the other and not the consideration of one measurement. For example, to treat the secondary anemia of this patient, without the consideration of the high sedimentation rate, high calcium, low phosphorus, and high blood sugar, would be an error.

Thyroid and estrogen seem to be used by a great many physicians. These hormones may provide symptomatic relief, but in turn they may create an unwholesome dental condition.

Permission was obtained from the patient's husband, a physician, to discontinue the intake of estrogen and thyroid for a period of two weeks. No special diet was prescribed. The patient was asked to cooperate fully in the total abstinence from all foods to which refined sugar had been added, and also white flour products. Fruits and vegetables were to be eaten as desired, with emphasis placed upon the increased intake of proteins.

For the first two days, her headaches and arthritic pains increased in severity and she felt "miserable." Then these pains became lessened, and at the end of the first week they had disappeared almost entirely. Constipation, which had been a problem for more than twenty years, had become alleviated; no longer was she required to use cathartics. In these two weeks the hot flushes which were giving her much distress (even with estrogen therapy) and the fatigued feeling had disappeared. She was enjoying a sense of well-being for the first time in many years.

Optimum levels in blood-urine chemistry are indicative of a state of well-being. These optimum levels are based on many thousands of patients who had abstained from refined sugar and white flour food stuffs. A yard stick had to be designed to measure not only the severity but the progress of treatment, and the probable recovery from disease. The results of this patient's second biochemical index are shown in Table II.

It will be noted that improvement occurred in each test, especially in the sedimentation rate, changing from 45 to 17. Sometimes it takes several months to accomplish what this patient did in two weeks, and one must admit that the treatment was rather simple.

I do no intend the leave the impression that all patients will respond to such simple procedures as this one. They will not.

In view of the remarkable result which was obtained with this patient, I advised her to have her new denture made (the sixth) and continue with her dietary regime. This was three years ago and she is still wearing the last denture comfortably. Her general health has been good. Only when she takes a "vacation" from her diet will her headaches and arthritic pains return. The mechanics are very complex and not fully understood and one needs but ask this question in any therapeutic procedure, "Will it work on Mrs. Smith?"

TABLE II

	TEMPERATURE	BLOOD PRESSURE	URINE			
			pH.	SP. GR.	CA PPT.	INDICAN
Optimum levels	97.6°	120–70	5.5	1.020	Slight	0
Second visit (Diet)	97.4°	110–70	5.5	1.010	Slight	0

	BLOOD CHEMISTRY					
	SED.	CA	P	HEM.	HB.	B.S.
Optimum levels	1.5	10.0	3.5	4.2	85%	100
Second visit (Diet)	1.7	10.2	3.3	4.0	80%	103

SOME OBSERVATIONS ABOUT SUGAR

Both clinical and laboratory observations have compelled me to reach this decision: I insist that all patients who are being treated by me for various mouth conditions shall abstain from refined sugar products (all pastries, ice cream, jams, jellies, fruit preserves, candy, chewing gum, bottled beverages, and like foods), refined flour (noodles, biscuits, pancakes, waffles, pastries, and cookies). Some patients have an intense craving for sweets, and I allow natural sweets such as honey, raisins, dates, and figs to be eaten, but not in excess. In some cases, even these must be eliminated.

The works of Becks,[5] Jay,[6, 7] Bunting,[8] and others have shown that a reduction of 80 per cent of *Lactobacillus acidophilus* index can be obtained by removing sugar from the diet. Unfortunately, the knowledge of this work led to a widespread belief that sugar only harmed the teeth, or rather activated caries. This thinking is not confined to the laity but has carved its niche in some dental minds. I have seen the following dental diseases respond to this type of therapy in some patients: Loose teeth, chronic bleeding gums, recurrent herpes, chronic Vincent's infection, bone loss, purulent areas in the gums, bone loss under dentures, chronic sore mouth under dental appliances, gagging, teeth hypersensitive to thermal changes, acute pericementitis, and recurrent dry sockets.

Hypertension in the adult is affected by the withdrawal of sugars. One patient's blood pressure (of long standing) dropped from 260/150 to 150/100 mm. Hg in two weeks. This was a remarkable improvement both in the systolic and diastolic pressures. Hypotention, frequency of colds and sore throat, chronic sinusitis, hay fever, allergies to food stuffs, dermatitis, gas after eating, flatulence, chronic constipation, neuritis, arthritis, chronic fatigue, tachycardia, cardial arrythmia, are likewise affected. In chronic fatigue, fully 75 per cent of the patients will respond to this diet, and some will report a sense of well-being they had not experienced in years; yet these so-called energy foods were withdrawn from the diet.

THE ROLE OF VITAMINS

Some patients feel better when they are taking vitamins, others notice no difference. Yet when sugar and white flour products are removed from the diets of those taking vitamins, 75 per cent enjoy an even better sense of physical well-being. This statement is based not upon wishful thinking, but actual biochemical results. There are some patients who have become so indoctrinated as to the need for vitamins that to insist upon their abstinence will create more harm than good from a psychologic point of view.

From a biochemical viewpoint, using a device whereby one can measure his results, I have found that the need for supplemental vitamins has diminished to almost zero. This conclusion was based upon the effects of a diet comprised of high proteins, and good carbohydrates, and the fat intake was left to the individual's ability to handle fats and, most important, no sugar and no white flour were permitted.

When we consider the complexities of this human body, who am I to insist that a patient does not need vitamins when he insists he does. However, I make this concession to the patient: that they take natural sources of vitamins such as wheat germ and brewers yeast for the B complex, whole citrus fruits for vitamin C, cod liver oil (not concentrated) for A and D, and milk, buttermilk, or Yogurt for minerals.

Many patients feel that they must take some sort of pill or pills to either keep the evil spirits away or make them healthier. But in all seriousness, we prescribe kelp and bone meal tablets (three daily) to all of our patients in order to ensure that they are getting an adequate supply of minerals and trace minerals in the diet. Kelp contains 58 minerals including molybdenum, manganese, copper, iodine, and other trace minerals so essential to cellular health. Soils vary in their chemical composition but ocean water does not, so there is a constancy in the mineral-vitamin yield of kelp.

SOME SUGGESTIONS ON ENDOCRINE THERAPY

I wish I could place each endocrine in a certain category as to its usefulness in this or that dental condition, but I cannot. The reasons and justifications for the administration of fifteen different endocrine substances could not be contained in the space allotted to this article.

It appears to me that the lack of adequate pituitary secretion, especially the posterior lobe, is a major factor in contributing to dental diseases and many other general physical ailments.

Empirically the injection of from 3 to 5 units of insulin (U 40) together with .25 c.c. (maximum) of *obstetrical pituitary* (diluted posterior pituitary) along with the diet will produce a very gratifying result in many patients suffering from chronic sore mouth or rapid resorption. Subjective symptoms including headaches, sinusitis, nocturia, gas after eating, pale complexion, red mucous membranes, and constipation would justify the use of this combination of insulin and obstetrical pituitary.

Insulin alone may be used with the above subjective symptoms in doses not to exceed 5 units.

Gratifying results may be obtained when it is used as a preventive measure against dry sockets, or even as a measure of their treatment with this small dose. Mild insulin shock (sweating and tremors) can occur with some patients, but even this is exceedingly rare. If this should occur, have the patient eat something or drink a glass of orange juice immediately and discontinue further treatment.

Insulin-obstetrical pituitary combination has been used successfully in the treatment of a hyperemic pulp, odontalgia, and teeth hypersensitive to thermal changes. There is one word of caution as to their use. Posterior pituitary extract has a vasoconstrictor effect on the capillaries with the attendant blanching of the skin. A patient should be told of this effect, and assured that there is nothing to be alarmed about.

The safest and most scientific procedure is to have a blood chemistry run two days following the first injection. This will establish immediately whether or not the therapy selected will be of benefit to the patient, by using the optimal levels as an indicator.

This insulin and obstetrical pituitary combination has, in many instances, produced some very dramatic results from a "medical" point of view. These results were unintentional, and I know of no method to prevent them from happening.

SUMMARY

It is necessary to learn more about a patient's general condition before treatment of his dental needs is attempted. The skill of the dentist, and the painstaking, complicated techniques employed in mouth rehabilitation are sometimes all for naught because no attempt was made to remove the underlying basic cause of the trouble or at least to inform the patient of it.

How many of us have considered a patient who is in need of prosthetic appliances as a sick patient? Is it not logical to assume that a "perfectly healthy individual" would not be in need of dental services?

Help or assistance from the medical practitioner has all too often been wanting. Their training has not been too concerned with dental complexities. In considering the educational background of today's dentist, should we not strike out a little more boldly, and study, not only the local conditions, but the factors which produced the local conditions? That brings us up to only one factor—blood. Cells, whatever the type, can receive their nourishment from only one source—blood.

Studying mouth conditions without their relationship to the rest of the body is like studying the branch of a tree without its relationship to the other branches, the trunk, roots, and especially the soil chemistry.

The biochemical index which has been presented is a different approach in the therapeutic field but, when we consider that there are many unknown factors which it cannot include, there is much to be desired. It is my contention that sodium, potassium, magnesium, cholesterol, and so forth, cannot be studied separately in dental diseases (or any disease) without studying their relationship to other chemical factors in the blood.

One day perhaps nutrition or diet will have advanced to the state whereby they alone will be used to correct and prevent these degenerative diseases of the

mouth. I am certain, at this point, that the elimination of refined carbohydrates from the diets of patients is a major factor in controlling these diseases.

Endocrines come in for their share of attention, and more concentrated studies should be made, not on laboratory animals, but on human beings. Dramatic results in the dental field and other conditions have been obtained by their intelligent use. This field offers a direct challenge to the dental profession.

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INSTRUMENTS ESSENTIAL FOR OBTAINING DATA NEEDED IN MAKING A FUNCTIONAL DIAGNOSIS OF THE HUMAN MOUTH

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BASIC ORAL SCIENCES

DENTISTRY IN ITS SCIENTIFIC aspect is dedicated to promoting the general health of human beings. Its field, once restricted to just the crowns of the teeth, has been gradually enlarged through scientific education until it has encompassed the whole masticatory mechanism. Today the care of the oral organ depends for its success upon applying the fundamental biologic principles derived from the studies of the morphology, the anatomy, the physiology, the histology, and the pathology of this complex living mechanism. The shapes of the teeth, the forms of the cusps, the conformation of the dental arches, the peculiar formations of the jaw bones, the odd figures of the temporomandibular joints, and the contour of the gums, all have significance in our understanding of the total assemblage of the parts of the mouth. The anatomy of the parts of the mouth and their complex relationships to one another express for interpretation the reasons for the unique physiology of the eating organ. The physiology of the mouth, what it does and how it does its work, the roles of its muscles, its joints, its cusps, its bones, and its associated organs can become the very basis of mouth treatment, because the main purpose of modern dentistry is to restore and to maintain healthy oral functions. All parts of the mouth may suffer from discomfort, disease, and degeneration; hence, pathologic entities affecting the mouth must be familiar concepts to the practitioner. The insidious attack of disease upon the periodontium, for instance, makes the detailed knowledge of its normal tissues an essential to the dentist. The knowledge of the normal histology of the teeth, the gums, the bones, the muscles, and the joints is a prerequisite to an understanding of the histopathology of these parts. To repair or protect intelligently such a complex organ dentists have to be so familiar with it that, figuratively speaking, they could take it apart and put it back together correctly.

SKILL, THE SERVANT OF KNOWLEDGE

The proud skill of a dentist, at its best, is but a humble obedient servant of scientific knowledge of what is good for the mouth. The digital dexterity used to ease pain, or to replace lost tooth tissues or teeth with lifeless fillings, inlays, crowns, and pontics, or to move the teeth through the bone to more suitable positions, is helpful to oral health only if it fulfills the prescriptions dictated by a diag-

Read before the American Academy of Crown and Bridge Prosthodontics, Chicago, Ill., Feb. 4, 1956, and the Milwaukee Dental Forum, Milwaukee, Wis., Feb. 10, 1956.

Received for publication April 24, 1956.

nostic knowledge of oral physiologic conditions. This skill, applied to teeth as if they were isolated things apart from what they contribute to mouth welfare and health, can, no matter how well the gold is jewelled, or how it gleams with polish, or how its margins coalesce with the adjacent enamel, be useless and without physiologic sense, if the restorations made by it are not correlated in forms, structures, and positions with the active chewing functions of the mouth. The goodness of an inlay, perfect in fit, polish, and margins, is to be tested not solely by these three qualities, but also by its occlusal ridges, and how well they cooperate with their opposing ridges during the chewing motions of the jaws to dice and mince the food. The success of a bridge is to be judged not entirely by its strength, its dimensions, its smooth surfaces, and the fit of its abutments, but also by how it, as a replacement of lost teeth, fulfills the purpose of well-articulated teeth. The physiologic test of a partial denture is not based entirely upon the designs of its clasps, nor upon its harmlessness to adjacent teeth, not its conformity to the stress-bearing tissues, but, in a major degree, upon its restoration of the healthy chewing function of the mouth. The inlay, the crown, the bridge, and the partial denture are but elementary dental remedies, made, compounded, assembled, and inserted to maintain the optimum healthful function and integrity of the mouth. These remedies have to be made to suit the peculiar individual requirements discovered in the patient by the dentist in his study of the basic diagnostic data taken from the patient. The skill and the digital dexterity of the dentist reach high plateaus of service when they faithfully carry out the prescriptions derived from elevated diagnostic knowledge.

GROWTH OF DIAGNOSTIC KNOWLEDGE

The expansive modern conception of the diagnosis of oral malfunctions has grown out of the increased knowledge that has been gained by studying (1) the articulative* qualities and arrangements of the natural teeth, (2) the interrelations of the jaws while at work and in centric closure, (3) the regulative directional guidance afforded by the jaw joints, and (4) the offices of the chewing muscles that give movement and power to the oral mechanism.

TEETH DESIGNED FOR ARTICULATION

The teeth as they are arranged in the dental arches are physiologically collected as specially designed and size-graduated instruments, and are held firmly in the jaws by highly specialized tissues. Their purpose is to provide cutting edges. These edges exist on the blades of the incisors and on the ridges of the cusps. The blades occur in the front of the mouth where the largest arcs of lateral and vertical movements are described. The cusps decrease gradually in height and size from the cuspids back to the distal molars. This graduated decrease in the height and size of the cusps matches the graduated decrease in the length of the arcs described by the lateral and vertical movements made by the mandible. It is the ridges of the cusps that make dental articulation* possible. To be in

*The gnathologists' conception of articulation is a tridimensional arrangement of the cusps of the teeth that provides correct cuspal relations that cooperate accurately with those movements of the temporomandibular joints which are used in chewing.

articulation, the cusps have to be in suitable spatial relations, and the directions of their ridges have to be such that they can cooperate smoothly with the traveling centers of jaw rotation movements.

JAW RELATIONS

The mandible is not united by ligaments directly to the maxillae. It is suspended by ligaments from cranial bones, not from facial structures. It makes its impacts upon the maxillae through the intervening teeth. Yet, the matching size of the mandible to the length and width of the maxillae gives to the face a profile relation so that the lips, the cheeks, and the tongue can easily feed the food between the opposing teeth, or can rest tranquilly when the mouth is not at work. The mandible at rest has a relationship of rest, during which the opposing teeth are kept apart and the muscles that operate it are relaxed to tonic tension, but, when the jaw goes to work, it forsakes its rest position, and the ridges of the teeth cut through the food and, like the edges of a good wire-cutter, they seldom snap hard together. A wire-cutter becomes useless if its blades cease coming together evenly. Likewise the mandible that cannot bring the opposing cutting edges of the teeth evenly together either is out of relation with the upper jaw or else the teeth themselves are out of suitable relation. The test of articulation is the closure relation of the ridges of the opposing teeth. Once dentists believed that the teeth, by their interlockings and their positions, gave location to the mandible in the face, and determined its profile relations. This belief has given way to the knowledge that the mandible has a centric relation even when the teeth are gone. When the jaws have teeth, the mandible assumes this centric position just before the final closure is completed. When full closure is accomplished, none of the cusps should force the mandible forward against the centralizing tendency of the retracting muscles of the mandible.

HISTORY OF TEMPOROMANDIBULAR JOINT STUDIES

For more than a century and a quarter, dental investigators have been studying the anatomy and the physiology of the temporomandibular joints, and the kind of movements they make. But not until the latter half of the "twenties" of this century did any investigators develop sufficiently accurate instruments to record and make good use of these movements in treating dentulous patients. For nearly thirty-five years, the members of the Gnathological Society of California have devoted themselves to a study of the physiologic movements of these joints in subjects who had teeth. Before they commenced their studies, most of the joint investigators had tried to make exact recordings of the jaw movements in the edentulous patient. In their work, the gnathologists have discovered no new kinds of joint movements. They did affirm, by their studies and experiments, what Balkwill, Gysi, Bennett, and Walker had discovered. What they learned was how to determine in each patient what his condyle motions are, and how to record them on instruments that would reproduce them. They also learned, in great detail, how to relate the teeth through movements and reconstructions to these determined joint movements.

They were forced by their studies to conclude that the intercusping of the teeth in all the excursions in articulation should cooperate with the movements of the joints. They made use of a field of knowledge that had not been sufficiently tilled for more than a century.

THE OFFICE OF THE MASTICATORY MUSCLES

The muscles of mastication close the jaw, advance the condyles, move the condyles sidewise, centralize the condyles, and assist in opening the mandible. They furnish the motive power, but the articulative directions that the mandibular teeth take are determined by the movements that the joints make. Granger[1] states it this way: "The movements of the mandible and the articulation of the teeth are activated by the muscles of mastication, but they are controlled by the temporomandibular joints." If the joints become immobile, the muscles can make no movements in occlusion. Contrariwise, the masticatory mechanism would be helpless, should the muscles lose their actions. But the nature of the jaw's joints in the individual determines his condyle paths, their curvatures and their inclinations. The way in which the joints house the condyles determines the side shift of the condyles. It is the condyle movements that are regarded as factors of articulation, not the patterns of muscle action.

BASIC CONDYLE MOTIONS

The condyle, during the jaw motions, does not bob up and down or about in its sockets like the end of a broomstick during hasty sweeping actions, nor does it sway like the suspension strip of a pendulum, nor does it follow a pattern of trained movements directed by habituated muscles like the point of a pen in free handwriting. The mandible has, within a given range, much freedom of movement, but the condyles are limited to just two kinds of movements. They can rotate and they can slide. All of the movements of the mandible are made possible because the condyles can rotate and slide in many combinations. The easiest condyle movement to comprehend and to witness is the opening-closing rotation about an axis that crosses the face horizontally and passes through the condyles at some distance below the meniscuses. This axis can be located directly by instruments quite accurately, because this motion can, with care and good technique, be isolated from the sliding actions of the condyles. In each condyle there is a vertical axis of rotation about which lateral jaw movements are made. This rotation axis is harder to understand or to witness or to determine, because, for instance, in a right lateral jaw rotation the left condyle must advance: hence, it cannot be isolated from all other movements. Moreover, very often in individuals, the lateral rotating condyle axis must move outwardly to accommodate the inward gliding of the opposite protracted condyle to which it is tied by the branches and the body of the mandible. Then, too, the lateral movement of the mandible cannot be made without a certain amount of mouth opening which tilts the lateral axis. But suitable instruments put upon the patient can lay hold of the right kind of data, so that they can be transferred to a faithfully recording articulator on which this axis can be determined and studied.

CONDYLE SLIDINGS, ALSO BASIC MOTIONS

Speaking generally there are two sorts of condyle sliding movements. One type is the fore-and-rear sliding; the other is the outward-and-inward sliding. The reciprocal fore-and-rear movement has long been associated with the condyle paths. The reciprocal outward-and-inward movement has, since the work of Bennett, been called the Bennett movement or the Bennett path, or the side shift of the condyle. The advancing condyles do not come straight forward but also downward, because they are guided by the eminences. If forwarded equally, or bilaterally, the condyles travel the opening-closing axis downward and forward. In the lateral mandibular movement the advancing condyle travels not only downward and forward but also inward, and does not follow the same path that it follows in the bilateral condylar protraction. It is the inward movement of the advancing condyle that compels the outward side shift of the vertical rotation axis of the "working" condyle. Thus, we see, the sliding movements of the condyles serve to move the lateral vertical axis and the opening-closing axis of rotations, and to put them in positions so that the mandible can make all of its complicated movements. To the mind schooled in mechanics, it is obvious that three axes of rotations guided about by two, three, or four camlike movements are capable of producing a large variety of movements in a well-designed machine. Many of our most intelligently made machines use these principles of motion controls to satisfy their intended purposes.

FORMER MISAPPREHENSIONS

The casual observer, who has not studied condyle motions by experimental means, but who looks chiefly at the chin of a moving jaw in its wide range of motions, is likely to conclude that the joints obey no principles of dynamics. The dentist, who has not given studious attention to condylar dynamics, while peering into the mouth and seeing the many closure positions is likely to infer that the condyles lack orderly and constant movements. The long neglect of dental institutions to analyze the dynamics of the condyles has allowed an undisciplined conception of the office of the temporomandibular joints to grow up in the profession. We hear stated orally, seldom in print, that there are a dozen acceptable centric "bites," that the opening-closing axis of the mandible may be put too far to the rear, that there are "a thousand different axes of condyle rotations," that the meniscus is very compressible, that the joint is quite adaptable, and readily adjustable to the compelling positions of the teeth which are the regulators of the joint movements, that the joints modify their movements to accommodate the interlocking of the teeth, and that the joints are too far away from the dental stage to take part in the drama of oral physiology. It is hard to disengage our minds from these grown-up misconceptions, but dentists being learned men can discipline their thinking to accept correct concepts if they are shown the facts.

INFORMATION FROM THE PURE ANATOMISTS

Even lacking experimental facts, the pure anatomists have, for a long time, been describing amply how the jaw joints are so structured that they can and

do provide all the condylar movements. They have, by their descriptions, furnished dentists who wanted to investigate such movements reliable information that leads to a clear understanding of joint dynamics. They named the joint by its action, described the capsule in which it is enveloped, explained how the articular disc separates it into upper and lower compartments, stated how the condyle moves behind and beneath the eminence, pointed out how the muscles are attached to protract and retract the condyle, propounded how the mandible is raised and lowered, and given us a clue as to how the muscles centralize the condyle. They have called it a hinge-sliding joint—a ginglymoarthrodial joint. The enveloping capsule is a bandage of tissue surrounding the condyle and the disc (the meniscus). It is "attached above to the circumference of the mandibular fossa"[2] of the temporal bone, also to the front of the undersurface of the articular eminence, and below to the neck of the condyle. The part of the capsule between the temporal bone and the disc is loose, and permits the sliding movements of the condyle. But between the disc and the condyle the capsule is firmer, and appears structured as if there are collateral ligaments binding the disc functionally to the condyle, in order to keep the hinge parts of the joint firmly together.

The synovial cavity above the disc conforms in shape to the contour of the mandibular fossa and the posterior and undersurface of the eminence. It is larger and looser than the synovial cavity beneath the disc and permits a ready sliding of the condyle. The lower synovial cavity caps the condyle, and accompanies it in its excursions. To insure this accompaniment fully, the disc is attached to a part of the external pterygoid muscle. This muscle protracts the hinge part of the joint. The condyle is guided downward as it goes forward by the eminence. It is the steepness of the eminence that determines the steepness of the condyle path.

No retracting muscles are directly attached to the condyle. The retractors of the condyle, however, are the posterior fibers of the temporal muscle, the deeper portion of the masseter, and to quite an extent the geniohyoid and digastric muscles. These muscles working with the elevators of the mandible carry the condyle back to its central position. They act as antagonists to the external pterygoids. Aside and beyond the clear descriptions of the structures of the temporomandibular joint, the pure anatomists have, in a general way, described all the movements of the condyles, their rotation axes, and the cam-actions they make in carrying about these axes to permit the mandible to make all of its so-called "free" and gliding articulative movements.

SIGNIFICANCE OF THIS JOINT ANATOMY

It will be helpful for us to give attention to the significance of this anatomic entity, the temporomandibular joint. Let us think about the importance of the way in which these two compartments of the joints are related to the bones that carry the teeth. The maxillae are fixed rigidly to the cranium through intermediary fused bones and processes. To all intents and purposes, mechanically speaking, the temporal suspension of the joint, the eminences, the characterful mandibular fossae, the upper compartments of the joints are, in effect, maxillary portions of

the mouth. The lower compartments of the joints, the meniscuses, the condyles, the lower synovial cavities, and the lower portions of the capsules are mandibular portions of the mouth. Here, we see, the parts that cause the slidings of the joints, and the directions that these cam-actions take, belong fixedly to the maxillae and their teeth. The slant of the condyle caused by the character of the eminence and the direction of the Bennett movement, caused perhaps by the character of the inner curbing of the mandibular fossa, remain in constant relation to the maxillary teeth, to the occlusal plane of the upper arch, and to the resultant curves of the upper arch, namely, the Spee and Wilson curves. On the other hand, the rotation axes, the horizontal opening-closing and the lateral vertical condyle axes, belong to the mandible, and no matter in what positions the mandible may be placed by the muscles and the slidings, these centers of rotation remain constant to the mandibular teeth and their arch arrangements. This anatomic view, this mechanical conception, this understanding of the relations of the upper and lower parts of the mouth to the cams and the centers of rotation is important, if we are going to make counterparts of the mouth or articulators that will copy the movements of the joints and the relationship of its parts. Mounted casts on an articulator must reproduce proper mouth relations in order to reproduce the correct movements of the mandible.

WHAT SHOULD BE EXPECTED OF AN ARTICULATOR

Gone are the dreams and hopes of articulator inventors that articulators can be made sufficiently adjustable to copy the movements of all mandibles without the substitution of parts that control the cam-actions of the joints. It is impossible to match, on an instrument, the infinite variety of joint movements that patients have, if it has only one pair of condyles and one pair of Bennett cams. The shape and form of the eminences, the depth of the fossae, the contour and form of the condyles vary so much from individual to individual that the path of the horizontal mouth axis, in the downward-forward paths varies so widely in slants and line character that a given geometrically made slot is not suitable for all patients.

The Gnathological Society, led by McCollum, approached a solution of this by having several sets of condyle slots made. From these, the path curvature that more nearly suited the patient's requirements could be selected and inserted into the condyle housing. The slant could be adjusted, but the slot had to be selected. These slots were based upon arcs of circles of various radii, but even then, in certain patients, they had to remachine the chosen slot to satisfy an extreme requirement. The direction, the timing of the action, and the line character of the Bennett path of the vertical axes of lateral rotation vary so much that no one Bennett cam control can be made that will be adjustable enough to reproduce all the various Bennett movements found. The group approached a solution of this by segmenting the horizontal bar representing the opening-closing axis of the instrument, and by grinding-in the Bennett cams for each patient. They had to eliminate much of the horizontal axle bar so they could tilt and turn the remnant segments left in the stirrup carriage. In this way, it was possible to copy the variations of the Bennett paths.

These investigators were forced to bow to the fact that an articulator should consist of a maxillary and a mandibular frame into which suitable cams could be inserted by a trial-and-error method of first selecting the more suitable ones, and then finishing their adaptations by grinding. It has been stated that an articulator must be assembled and made for each patient. Consequently, what should be expected of an articulator is the individual expression of the condylar movements of a patient, something that may differ from all other patients.

STUART'S DEPARTURE

Stuart, who has matured in the Gnathological Society, and who has done much experimental work and assisted in nearly all of the investigations, became convinced that an articulator should copy the dynamic principles of joint motions, but should be less compromising in certain details than former instruments. He believed that the axes of mandibular rotations should be amply provided for functionally, but not mechanically built into the articulator. Therefore, he discarded the horizontal axis so commonly seen in current articulators, but faithfully provided for a functional axle. He knew that the Bennett paths have a variety of directions, so he made an instrument that would yield readily to the direction of the condyle path that the patient required, but timed the action by grinding the cam that controls the beginning of the movement. He knew that the condyle paths are various, so he made replaceable eminences that could be selected and slanted to follow the paths drawn by the patients, but he could easily grind these eminences to suit the waves and bumps sometimes found in the articulative portion of the condyle path. He made the settings of the lateral rotation centers easily available for adjustment. He has made the adjustable parts available, and devised the instrument so that suitable selected parts may be inserted. He has made the instrument so it will accept the data found in the patient's motions by the jaw-writing instruments without resistance.

HISTORY OF JAW WRITINGS

Before expatiating upon the jaw-writing apparatus, let us review briefly the history of these devices, because they began simply and were made to satisfy a single principle. As they grew in complexity, the techniques of their uses were changed, and other attachments were made to satisfy a newer principle discovered. With increased use and with enlarged appetites to gain more and more data to be used to set the articulator, other attachments were made and added, until now, unless you understand the principles exemplified, a jaw-writing instrument appears so complicated that it seems, to one not familiar with the purposes, to be a Rube Goldberg's nonsense device. Goldberg's drawings were made to entertain, but the pictures of the writing devices put upon jaws look so complicated that, sometimes, they make dentists viewing them mad. Stuart's aim in redesigning the jaw-writing instrument is to make it less complicated, easier to use, and at the same time increase its accuracy.

SNOW'S FACE-BOW

In 1899 Snow made a bow that he used to position the casts of the edentulous mouth upon the articulator so they would have the same relation to the joints

of the articulator as the ridges of the jaws have to the temporomandibular joints. It was considered quite a complicated instrument by the then practicing dentists, although it was known as a one-piece instrument. It was a U-shaped tube that had a toggle to attach it to the bite fork, and a blunt stylus at each end to point to the opening-closing axis. The axis was located by fingering the skin over the joints while the patient was opening and closing. Wadsworth made it a bit more complicated by adding another toggle in front to attach his T-bar. This was used to keep, in succeeding mountings, the upper teeth in the same relations to his unadjustable condyle paths as he had in the first mounting. The use of the T-bar was the first attempt to put into effect a tridimensional mounting of casts on an articulator. It was done to keep the upper teeth and casts in a constant relation to the cam slots of an articulator—the condyle paths.

THE ADJUSTABLE HINGE-BOW

In 1921 it was suggested by Robert Harlan that the Gnathological Society use the Snow face-bow in an entirely different way. Snow used it upon the cast and teeth of the upper jaw. Because of this suggestion, these investigators found they could fasten it to the lower teeth and, by having the patient open and close without using the protractors of the mandible, determine on the side of the patient's face a point of only rotary movement. This, they saw, was the opening-closing axis of the mandible when it was in its most posterior position. It was hard to use the rigid one-piece bow in making such a determination. After much labor and with great difficulty, these men developed an adjustable axis bow consisting essentially of three major parts, namely, a front horizontal bar and two side arms that had slow screw adjustments. They also modified the Wadsworth T-bar so they could more easily locate and register the axis-orbital plane of the face.

THE MANDIBULAR CLUTCH

One of the handicaps the Gnathological Society overcame in determining the location of the centric position of the opening-closing axis of the mandible was a way to fasten the axis bow firmly to the lower teeth. After many trials, they combined the efforts of many to make a two-piece aluminum cast clutch that would grip the necks of the teeth evenly, and could be clamped on firmly without using cement or covering over the occlusal surfaces of the crowns of the teeth. In the beginning of this work, they did not realize how widely a patient could open the mandible about the axis and still keep it in centric position.

THE MAXILLARY CLUTCH AND FACE-BOW

In their more scientific work with the axis bow, it was found advisable to put recording cards in front of the ears. They found that the cards could be held best in the condyle regions by attaching them below the tragus ends of the maxillary three-piece face-bow that was securely attached to the upper teeth. Later they substituted glass slides with a thin wax coating for the cards, and sharp styluses for pencils so they could work to finer lines. With this device, it was found

that the condyle drawings made by the patient during condylar protraction was a constant line, if started from the axis centric position. They could make the drawings on one day, preserve the record, take off the equipment, lay it aside and rest the patient. At subsequent times, they could reassemble the equipment upon the patient, locate the centric axis position, have the patient redraw the condyle path by protraction of the condyle. In this way these men found that the condyle path was a constant. Moreover, in any stage of condyle protraction, the patient could open and close, and the stylus would remain on the drawn line.

They did what Gysi had neglected to do. Gysi was never able to get the condyle in the same patient to make the same kind of a line writing because his writing device was not rigidly fastened to the teeth, and he did not fix his writing card always in the same place, nor did he always start from the same point; hence, his conclusion that the path of the same condyle varied was an ironic error. Consequently, it was assumed by many dentists, who were half familiar with the anatomy of the joint but fully informed of Gysi's conclusion, that the joint movements in the patient were inconstant, variable, and subject to the whims of the muscles, or bobbed about by interfering teeth. It will take many years to erase from the minds of dentists and dental writers this ironic mistake of Gysi. No doubt, this finding of the Gnathological Society is the greatest contribution that they have ever made to dental science, for, they proved that the pattern of condyle movements for a given patient is fixed and independent of teeth and muscles.

MAKING USE OF CONDYLE WRITINGS

By 1933, about twelve years after these investigators made the first determination of the centric location of the opening-closing axis of the mandible by an instrument, the gnathologists had gained considerable certain knowledge about the movements of the condyles. They had learned how the most retracted physiologic position of the opening-closing axis varies in facial relations, that it bears no constant distance from the tip of the tragus, that it expresses centric maxillo-mandibular relations, that it travels in the condyle paths, and serves as the opening-closing axis of the mandible, no matter where the jaw goes, and that the teeth and cusps in their final closure should not pull it forward by interferences. They had learned how the rotating condyle of lateral mandibular movement first seeks its neutral retracted position, then commences the rotation, and moves sidewise to compensate for the medial movement of the protracted condyle on the other side of the face. By a series of experiments, they found out how the various slants and curvatures of the condyle paths demand either changes in cusp heights or modifications in the curve of Spee, also how the various Bennett movements in their variations call for directional requirements of the transverse ridges of the posterior teeth and alterations in the curvature of the Wilson curve. In short, they found what the patterns of axes positions and axes movements on the condyles demand in teeth positions, cuspal forms, cuspal sizes, cuspal heights, and cuspal arrangements to effect articulation. It would take a full-sized well-illustrated book to cover the interplay of the articulative factors found in the joints with the factors of articulation found in the dental portion of the oral mechanism. They had learned that the

factors of articulation issuing from the joint are fixed, and could not be changed by the hand of man or the misfit of teeth, but that the correspondent factors associated with the teeth and their curves of arrangment could be altered to a great degree, so that the instruments of mastication could be put in compliance with the demands of the fixed factors in the inoperable unadaptable joints.

INADEQUACIES OF INTEROCCLUSAL RECORDS

Before making use of jaw-writing devices, dentists had relied upon centric, protrusive and lateral interocclusal records (bites) made of various materials to obtain positional data for setting a supposedly adjustable articulator. At best, an interocclusal record can only register the end position of a path. It does not and cannot register the character of the path between the centric position and the position obtained in the interocclusal record. The most important part to ascertain and record and make use of in the path of the condyle or in the path of a Bennett movement is that used by the patient when he is chewing closely. No matter how carefully interocclusal records are made, they cannot give, to an articulator, controls that will reproduce the important articulative portion of the axes paths. This can only be done by jaw-writing devices.

ADAPTATION OF FACE-BOWS TO WRITE JAW MOTIONS

With the full knowledge of the inadequacies of interocclusal records, MacQueen, Stuart, and Wightman decided to add to the maxillary and mandibular face-bows, devices that would write and record all the movements of the mandible, and seek a way to transfer this data to an articulator that would reproduce the same movements made by the patient. So, they modified the apparatus that had been used to investigate and study the character of the condyle paths. They made a device consisting of a maxillary bow to hold the flags of records, and a mandibular bow to carry the writing points. They made this assemblage record the condyle paths, the Bennett paths, and the needle-point (Gothic arch) tracings, and incidentally the centric relation of the jaws. For convenience of the operator's vision, they attached the record flags for the needle-point tracings upon the mandibular frame, and the styluses upon the maxillary frame. They made adaptations to be put upon and in the articulator that would readily copy these records, and compellingly make the machine reproduce the same movements. Their first model of the writing device was complicated, and it was actually built and assembled solidly upon the patient. Later, it was adapted so it could be used more freely in clinical conditions. The refined jaw-writing device was still complicated, and required three persons to apply and use it. Since 1950 Stuart has worked to improve it by adding simpler styluses and record flags, so an operator and one assistant can take the needed data quicker and easier, and at the same time more accurately.

WHAT IS A JAW-WRITING DEVICE?

The jaw-writing device is a tridimensional caliper, consisting of a maxillary frame to hold the record flags, and a mandibular frame to carry the writing points, that can be used to determine the dimensional relation of the teeth and jaws to the

cams and the axes of the joint movements, on a patient. Properly adjusted and carefully applied, it will produce the data from which the dentist can determine and locate the centric axis position of the opening-closing action of the mandible, establish the slant and curvature of the condyle paths, set and direct the amount and direction of the Bennett paths, and keep these factors knitted together. These data can be literally poured into an articulator assemblage that can be made by settings and grindings of selected parts to reproduce the movements that the patient makes without any compromises.

WHY HAVE ARTICULATED MOUNTED CASTS?

A functional diagnosis of the mouth cannot be made by examining the teeth in their various closure positions or by studying hand-held unrelated casts. It cannot be made by watching the glidings of the teeth in the mouth. It cannot be made by listening to the clickings of the joints and the tappings of the teeth. It cannot be made from roentgenographs of the joints. A functional diagnosis can only be made by studying the relationship of the jaws, the interrelations of the opposing teeth, and the relation between the dental factors and the condyle factors of articulation, as they are revealed when the dental casts are mounted upon a duplicating instrument that puts the teeth and jaws together with faithful regard to the moving axes and the cam-actions, just as they are in the patient. In such a mounting, the presence or the absence of a centric closure can be detected. If the interdigitated cusps do not permit a centric closure, the cusps causing the protrusive closure can be detected clearly. The amount of the eccentricity of the occlusion can be measured. Thus, the magnitude of the dysfunction can be ascertained. The presence or the lack of even cuspal contacts in the lateral closures can be witnessed accurately. The teeth that stumble the gliding from lateral to centric position can be spotted, and the amount of functional disturbance can be weighed with roentgenographic data. The greatness of the vertical overlap of the incisors can be studied with accuracy. How the positions and the misrotations of the molars fight with the Bennett factors can be ascertained; and, if it is desirable, the minute details of the misfitting of the opposing ridges of the cusps can be studied with a view toward a correction. Such mountings afford the dentist a mass of details, both little and big, for him to study in a manner that is not available from any other methods yet discovered. In such mountings are written the history and the causes of the ruins of the teeth and the periodontium. In them can be read the remedies needed for restoring the functions of the mouth. All this work, all this trouble, all these instruments, and all these techniques to acquire the data are necessary to gain that intimate knowledge of the mouth that is needed to discover what is wrong, what is right, and what can be done to bring back the mouth to a physiologic status.

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RE-EVALUATION OF THE CANTILEVER PRINCIPLE

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SEVERAL AUTHORS HAVE ATTEMPTED to define the cantilever bridge in various ways, but Tylman has given us the clearest definition. He defines a cantilever bridge as one which has one or more abutments at one end of the bridge while the other end is unsupported.[1] Such terms as "swing on" or "free end" are synonymous with the term cantilever. Those who have had wide clinical experience are aware of the fact that, in the past, this type of bridge design was extensively employed. It is interesting to note that very little material about it has appeared in the literature during the past twenty years. No article exclusively on the cantilever principle has been written, and such men as McCall, Hugel, Prothero, Schwartz, Schweitzer, and Tylman wrote in a limited manner on the subject. This would seem to indicate that although the principle was accepted by the profession, it was not completely understood, but merely applied empirically. The results of such a procedure were quite evidently demonstrated by mountains of clinical evidence in the form of periodontially and periapically involved teeth. Fig. 1 illustrates tissue breakdown due to improperly applied cantilever bridges. Such conditions existed because this principle was applied widely without regard for, or a biologic understanding of, a mechanical princple. The result was extensive tissue destruction and damage. In retrospect, it now seems apparent that this one violation of bridge design did more to placed fixed bridgework in ill repute than anything else.

On the other side of our clinical ledger, we found in many instances where this principle was employed in keeping with the patient's biologic limitations that such bridges gave prolonged periods of service, and did not cause tissue destruction or damage. This provokes thought as to why certain of these bridges failed and certain others were successful. Using this thought as a yardstick, it might prove helpful in securing or formulating some answers, and in guiding future thinking in regard to treatment planning procedures.

The rigid bridge design is always to be preferred. However, the cantilever principle, when properly applied, will serve as an excellent compromise to meet clinical conditions and give the patient prolonged periods of service at a fee level within his economic limitations.

Received for publication April 21, 1956.

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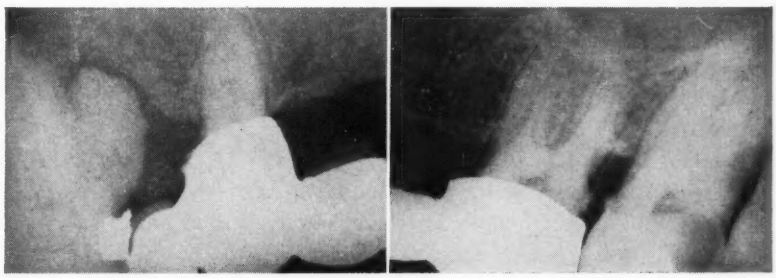
PHYSIOLOGIC APPRAISAL

The term physiologic appraisal may be defined as the total knowledge gained as a result of a complete oral examination plus extensive personal clinical experience. Prior to treatment procedures for all types of restorations, a physiologic appraisal should always be made. There is no substitute for extensive clinical experience, and no age group has it monopolized. In the final analysis of all treatment planning, the one and most important factor is the operator's clinical experience. If such an experience has been wide and varied, his conclusions and decision will prove to be of inestimable value. If, however, such experience has been limited, caution should be exercised.

Application of the cantilever principle for restorative programs necessitates a careful physiologic appraisal before a final decision is made to employ this principle. Such a decision is predicated on the following favorable clinical conditions: (1) good periodontal attachment, (2) good alveolar support, (3) favorable root length, shape, and crown length, (4) favorable arch-to-arch relationship, and (5) favorable tooth-to-tooth relationship.



A. *B.*

Fig. 1.—Extensive hard and soft tissue destruction resulting from improper application of the cantilever principle.

PERIODONTAL MEMBRANE

The periodontal membrane is the most important of all dental tissues. The statement: "No periodontal membrane—no alveolar bone—no tooth," credited to Fox,* forcefully brings to our attention the importance of this structure. Tylman has called the periodontal membrane the foundation of all restorative dentistry.[2] In our physiologic appraisal, this one structure must be carefully evaluated when considering restorations, particularly when the cantilever principle is to be employed. Biologic limitations cannot be formulated on the basis of a mathematical formula, but Ante proposes the following formula. The total periodontal membrane area of the abutment teeth should equal or exceed that of the teeth to be replaced.[3] Using the following table of square millimeters of periodontal membrane for each tooth may aid us in our final decision.[4]

For example: if we were to replace an upper cuspid tooth in which double attachments on the first and second bicuspids were employed, we would have an area of periodontal membrane of 149 sq. mm. plus 140 sq. mm. respectively, or a

*Personal communication.

total of 289 sq. mm. Since the cuspid to be replaced has a periodontal membrane of 204 sq. mm., a certain degree of safety could be anticipated. Application of this rule to our clinical evaluating procedures will prove helpful in some measure.

TABLE I

UPPER TEETH	SQ. MM.	LOWER TEETH	SQ. MM.
Central incisor	139	Central incisor	103
Lateral incisor	112	Lateral incisor	124
Cuspid	204	Cuspid	159
First bicuspid	149	First bicuspid	130
Second bicuspid	140	Second bicuspid	135
First molar	335	First molar	352
Second molar	272	Second molar	282
Third molar	197	Third molar	190

If we were always dealing with teeth that have a complete periodontal attachment, such computations would be in a degree accurate; however, when dealing with teeth in which the square millimeter of attachment has been decreased, we must make an approximate evaluation or reduction in the capacity of such an attachment. When making such an evaluation, it must be recognized that the greatest area of attachment is at the cervical portion of the root and that it diminishes greatly toward the apex.[5]

Fig. 2 is shown, not to demonstrate the highest type of restorative dentistry, but the tremendous capacity of the periodontal membrane. Two gold shell crowns were used as abutment attachments on the upper right and left cuspids. These attachments carried *four* incisor pontics and *four* bicuspid pontics for a total of *eight* pontics. Upon questioning the patient, it was learned that this replacement had been in the mouth in excess of twenty years.

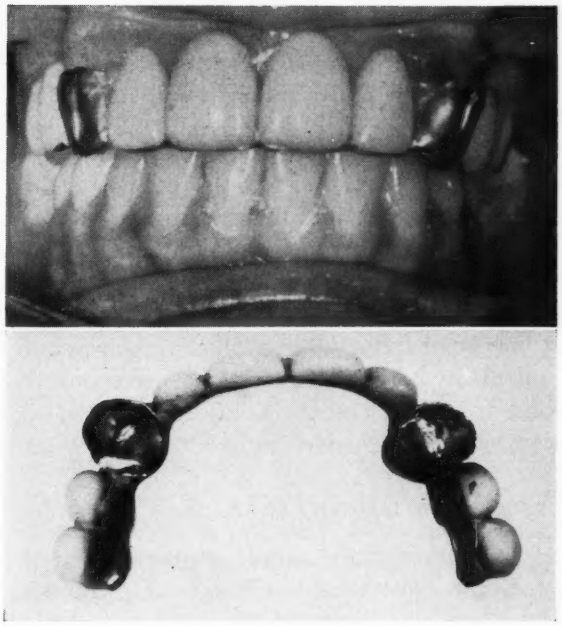
Fig. 3 illustrates a missing upper left central incisor. Use of the cantilever in this instance seemed inadvisable if only the lateral incisor was to be used as the abutment tooth. Since this patient was a dentist, and insisted on a conservative approach to his problem, a cantilever bridge was employed using only the lateral incisor as the abutment tooth with a mesial rest upon the adjacent central incisor. Daily contact with this patient over a period of fifteen years reveals this restoration to be in excellent condition at the present time.

Both illustrations clearly demonstrate a violation of all basic principles of bridge design, and they are not intended as a guide to thinking or planning of treatment procedures. However, both illustrations do demonstrate the adaptability and tremendous capacity of the periodontal membrane, and it behooves us to place this structure in the proper place in our thinking.

ALVEOLAR BONE

When it is anticipated that the cantilever principle is to be used, it is essential that the selected abutment teeth have a normal amount and proper distribution of alveolar bone. If such a condition does not exist, application of the rigid bridge principle would be more acceptable. The preferred type of alveolar process is one

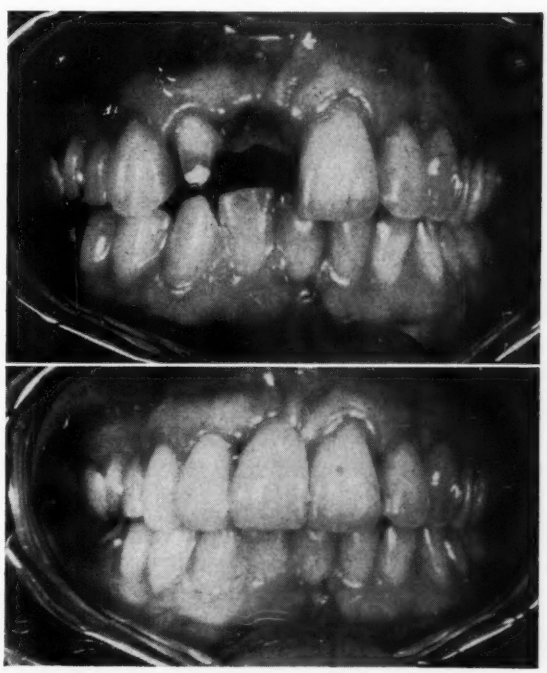
A.



B.

Fig. 2.—Four incisor pontics and four bicuspid pontics supplied by two gold shell crowns. This replacement gave the patient better than twenty years of service.

A.



B.

Fig. 3.—A fifteen-year-old cantilever restoration which employs the upper lateral incisor as the principal source of support.

which *completely surrounds the root* and extends to within 2 or 3 mm. of the cemento-enamel junction. Evidence revealing loss of alveolar bone to any degree on any one surface will of necessity cause a change in the original thought regarding the application of the cantilever principle. During roentgenographic examination, carefully observe the trabeculae of the cancellous bone. Such trabeculae should, if normal, be uniform in size, equal in distribution, and so arranged that they are perpendicular to the forces applied to the tooth or teeth.* If the trabeculae are found to be reduced in number, and their arrangement irregular and small, we must conclude that we are dealing with tissue of a limited capacity. Teeth whose alveolar bone has been lost in the amount of 50 per cent should not be used as bridge abutments, either of the rigid type or particularly of the cantilever type.

Age is a most important factor when evaluating bone, since it is quite evident that the vitality and ability to obtain a good bone response decreases with age. The biologic response is limited, and the ability to meet the added mechanical requirements of bridgework—particularly cantilever bridges—seems inadvisable.

FAVORABLE ROOT LENGTH, SHAPE, AND CROWN LENGTH

For successful application of the cantilever principle, teeth with long, broad, and properly directed roots must be used. Molar teeth with widely divergent roots are to be preferred. Molar and bicuspid teeth that have either fused or excessively conical roots are not acceptable. In general, conical root formation for the application of this principle is undesirable. Root formation that presents an oval or oblong shape in cross section is to be preferred, since such root anatomy will resist rotational forces.

Teeth with short anatomic crowns are not to be preferred, since they offer only limited abutment attachment to tooth structure area. Such attachments are easily affected by applied pressures, and these applied forces are quickly transferred to the underlying tissues. It is essential, upon the insertion of a cantilever bridge, that the abutment attachments are retentive to the higest degree, so that motion is kept within normal confines. This will preclude any loosening and failure of the attachments.

FAVORABLE ARCH-TO-ARCH RELATIONSHIP

The most favorable type of occlusion opposing the cantilever bridge is mucosa borne, in the form of either a partial or complete denture. These replacements exert limited force upon such bridges. The opposing natural occlusion, in order to be acceptable, must be extremely favorable. Arches possessing irregularities and in need of orthodontic treatment do not make a suitable opposing occlusion for such bridges. Patients exhibiting excessive wear patterns do not make a good selection for the employment of the cantilever principle.

Patient with "open bites" or with a mandibular protrusive relationship are acceptable when the cantilever principle is applied in the anterior section of the mouth, since under these conditions only limited forces are exerted.

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*Kotanchik, M. J.: Personal communication.

FAVORABLE TOOTH-TO-TOOTH RELATIONSHIP

A normal degree of vertical and horizontal overlap lends itself to the cantilever principle very well. An edge-to-edge relationship is also acceptable. Cross-bite occlusions should be examined very carefully in all excursions, since this relationship is not particularly desirable. The deep vertical overlap case is neither favorable nor acceptable. In this relationship, usually in the protrusive position, the anterior teeth are either under trauma or some degree of excessive pressure. This clinical condition, if the cantilever bridge is applied, invites disaster in the form of loosening, migrating teeth and early loss of such a restoration. In fact, if the rigid bridge is employed, such problems will also develop many times.

FUNCTIONAL DEMANDS OF THE PATIENT

If functional demands are kept within what might be considered normal, cantilever bridges can be expected to give long periods of service. If, however, patients use the teeth in some unusual manner in their occupation, or have unnatural habits in which excessive intra- or extraoral pressures are exerted, the cantilever bridge should not be used. This is particularly true in conjunction with the anterior cantilever bridge. Posterior cantilever bridges are less subject to excessive stresses from within or without the mouth than the anterior cantilever bridge.

Patients exhibiting excessive wear patterns are not considered favorable for the application of the cantilever bridge, since the vertical dimension is continually closing—thus, predisposing to excessive wear not only of natural tooth structure but also of the attachments and supplied pontics. This situation invites failure.

TYPES OF ABUTMENT ATTACHMENTS

When employing the cantilever principle, the *inlay should not be used* as a primary or major abutment attachment. The role of the inlay should be confined to auxillary retention in the form of rests or keyways. Inlays offer only limited retentive qualities, and are easily subject to normal occlusal changes. These two facts seem to substantiate the inadvisability of inlay use.

Full metal veneer crowns are to be preferred as abutment attachments, since they offer greater strength, highly efficient tenso-frictional grip, and superior protection to the underlying prepared tooth structure. Every effort should be made to produce full crown preparations that possess nearly parallel walls, particularly on the mesial and distal surfaces, as this will greatly aid in retention. Additional retention may be secured by placement of proximal grooves in the preparation. Such grooves develop tremendous gripping qualities.

If partial veneer (¾) crowns are to be used as abutment attachments, the axioproximal grooves should be made as deep as possible so as to minimize the rotational forces upon the casting. If additional retention is deemed advisable, it can be secured by placing a lingual pit in the cingulum and by making the axioproximal groove distal to the pontic heavier than the axioproximal groove adjacent to the pontic.* For example, a 701 fissure bur can be used for the mesial groove and a 702 or 703 for the distal groove in anterior preparations.

*Kotanchik, M. J.: Personal communication.

CLINICAL APPLICATION

The greatest need for the employment of the cantilever bridge was found in the past to be in anterior sections of the dental arches. Popular thought has been that posterior cantilever bridges were not only questionable but definitely contra-indicated. In fact, one of the cardinal rules of bridge design was never to suspend or cantilever a pontic posteriorly.

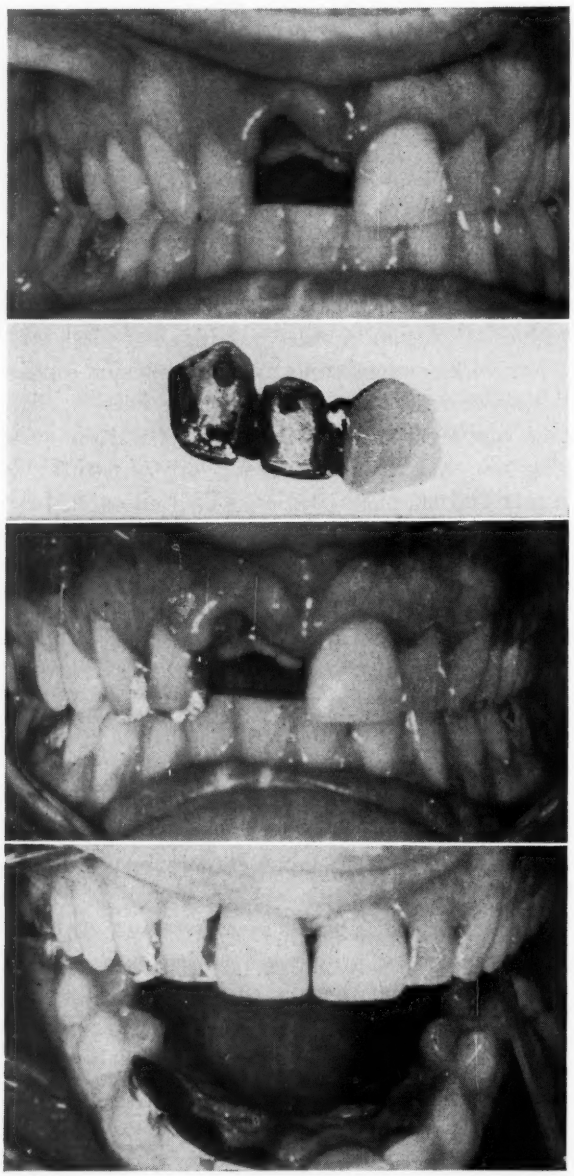


Fig. 4.—Double attachments provide adequate support for the central incisor pontic. Note the heavy axioproximal grooves and accessory retention in the form of lingual pins.

Recent clinical experiences have not only altered past thinking but proved conclusively that the cantilever principle can be employed both in the anterior and posterior sections of the mouth equally well.

Application of this principle in keeping with aforementioned factors, not only is acceptable, but it is the treatment plan of choice in some instances.

The following clinical conditions lend themselves favorably to the use of this principle.

1. *Replacement of an upper central incisor:* Since it sometimes is difficult to match an adjacent central incisor tooth in shade and symmetry, it is inadvisable to alter the adjoining central incisor, but better to place double attachments on the cuspid and lateral incisor and suspend the central incisor pontic as a cantilever. Some form of accessory retention is to be preferred in the form of a rest or key resting in an inlay on the adjacent natural central incisor. Fig. 4 illustrates such a clinical application.

2. *Replacement of an upper lateral incisor:* If the vertical and horizontal overlap is normal, and the cuspid has a good root formation with a normal attachment, such a pontic cantilevered from the cuspid will render many years of service (Fig. 5). If additional support is required, double attachments may be used on the cuspid and first bicuspid (Fig. 6). Accessory retention can be gained by a rest or a key resting in an inlay on the distal surface of the adjacent central incisor. If proper attention is given to the placement of the contact area, this will prove to be sufficient for retentive purposes and also permit the patient to clean this area more thoroughly.

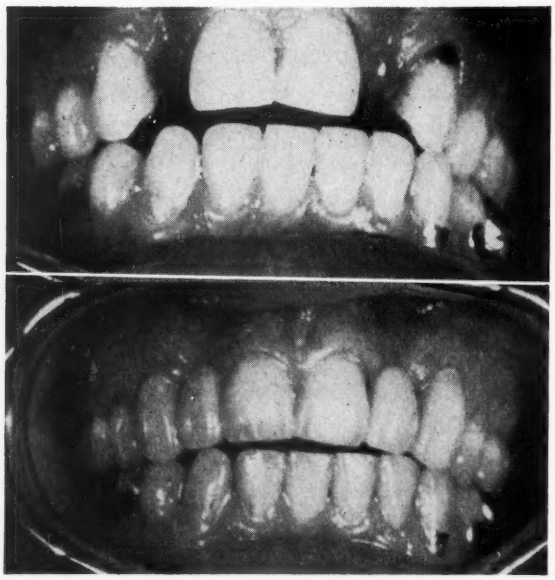
3. *Replacement of an upper cupsid:* Since the upper lateral incisor is a weak tooth, it does not lend itself favorably as an abutment attachment. An alternate plan, instead of a rigid bridge from the lateral incisor to the first bicuspid, would be double attachments on the first and second bicuspids cantilevering the cuspid pontic. If the adjacent first molar is in need of repair, it may be advisable to triple abut these three teeth, thus avoiding any undue leverage on the second bicuspid.

4. *Replacement of both upper lateral incisors:* If the upper cuspids and upper central incisors are in need of repair, one bridge can be designed from cuspid to cuspid with intermediate upper central incisor abutments. However, if the cuspid teeth are caries-free, and the central incisors are in need of repair, a bridge can be designed using both the central incisors as double attachments, cantilevering both lateral incisors (Fig. 7). Some form of auxillary support should be obtained on the mesial surface of both upper cuspids.

5. *Replacement of the lower central incisor, lower lateral incisor, and lower cuspid:* Replacement of any one of these teeth presents problems similar to the previous four groups. Treatment planning with regard to the application of the cantilever principle is quite the same for the lower arch as it is for the upper arch.

The previous applications have been confined to the anterior area of the dental arches. *Application of the cantilever bridge in the posterior areas should not be carried out on any large scale.* However, clinically, it has been found that the cantilever principle can be applied more frequently than previously believed since posterior stresses are not as great as they were thought to be. The posterior masticatory stroke is short and usually not excessive.

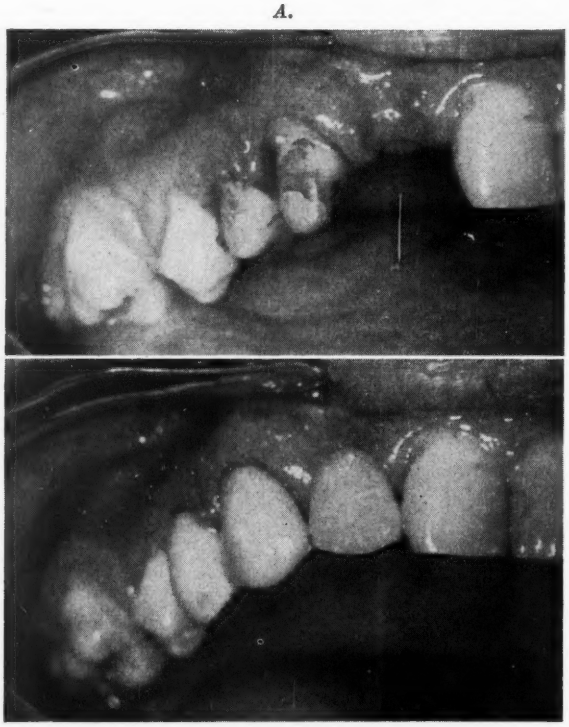
A.



B.

Fig. 5.—A frequent and satisfactory application of the cantilever principle. Longevity can be anticipated.

A.



B.

Fig. 6.—Double attachments on the first bicuspid and cuspid teeth provide more than the usual support for a lateral incisor pontic.

1. An excellent clinical application can be found in those patients in need of or wearing a *complete upper denture against a natural dentition from lower right second bicuspid to lower left second bicuspid.* All mandibular molars are missing, and the patient is in need of some type of replacement. A bilateral distal extension removable partial denture can be employed. However, an alternate plan might be to place double abutment attachments on the first and second bicuspids on both sides of the arch, and cantilever first molar pontics posteriorly. This would eliminate the need of a removable partial denture, and provide the patient with a more stable occlusion both immediately and in the future.

A.

B.

C.

Fig. 7.—Both central incisors are employed as double attachments, cantilevering both lateral incisor pontics. Auxillary support was provided by mesiolingual inlays for the reception of a semiprecision rest.

2. When it is desirable *to avoid insertion of a unilateral removable partial denture,* the cantilever principle may be used. Occasionally, in lower arches, we will see all of the molar teeth lost unilaterally. This would require the insertion of a unilateral removable partial denture. An alternate plan is found in using double attachments on the first and second bicuspids, and cantilevering a first molar pontic distally. This avoids the necessity for a removable partial denture. If there

exists any unopposed maxillary teeth posterior to the lower pontic, they can be stabilized by means of interlocking inlays or joined by crowns soldered together.

3. When the upper third molar is missing and the patient has lost the upper second molar, application of the cantilever principle is acceptable, provided the occlusal relationships are normal. Such a design would be to place double attachments on the upper first molar and second bicuspid, cantilevering a second molar pontic posteriorly (Fig. 8).[6] This pontic should be, if possible, reduced approximately one third, mesiodistally and buccolingually.

The same application and similar design can be used if the lower third molar is missing, and the patient has lost the lower second molar.

The following cases will serve to illustrate additional practical applications of this principle.

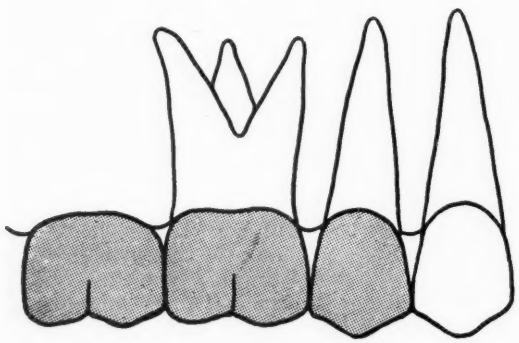


Fig. 8.—A posterior cantilever restoration utilizing double attachments on the first molar and the second bicuspid teeth supplying a second molar pontic. The size of all such pontics should be reduced approximately one third, mesiodistally and buccolingually.

Fig. 9 illustrates a case in which all of the right mandibular molars were missing. All other mandibular teeth were present. In the maxillae, the second and third molars and the first bicuspid were missing. Treatment consisted of placing acrylic resin veneer gold crowns in the form of double attachments on the mandibular right first and second bicuspid teeth, and cantilevering a first molar pontic posteriorly. In the maxillary arch, acrylic resin veneer gold crowns were placed in the form of double attachments on the first molar and second bicuspid teeth, and a first bicuspid pontic was cantilevered anteriorly.

As shown by the study casts (Fig. 10), the patient had lost all molar teeth except the mandibular left second molar. A decision was made to remove this tooth since it was periapically and periodontially involved. The patient had had numerous unsuccessful experiences with removable partial dentures over a period of years. The reason for failure was unimportant, be it psychologic or not, and the fact remained that there existed a need for restoration of occlusion. Removable partial dentures would not be accepted by the patient.

Treatment consisted of placing acrylic resin veneer gold crowns on the lower right cuspid and right second bicuspid teeth, and supplying the lower right first bicuspid and cantilevering a bicuspid pontic posteriorly. Acrylic resin veneer gold

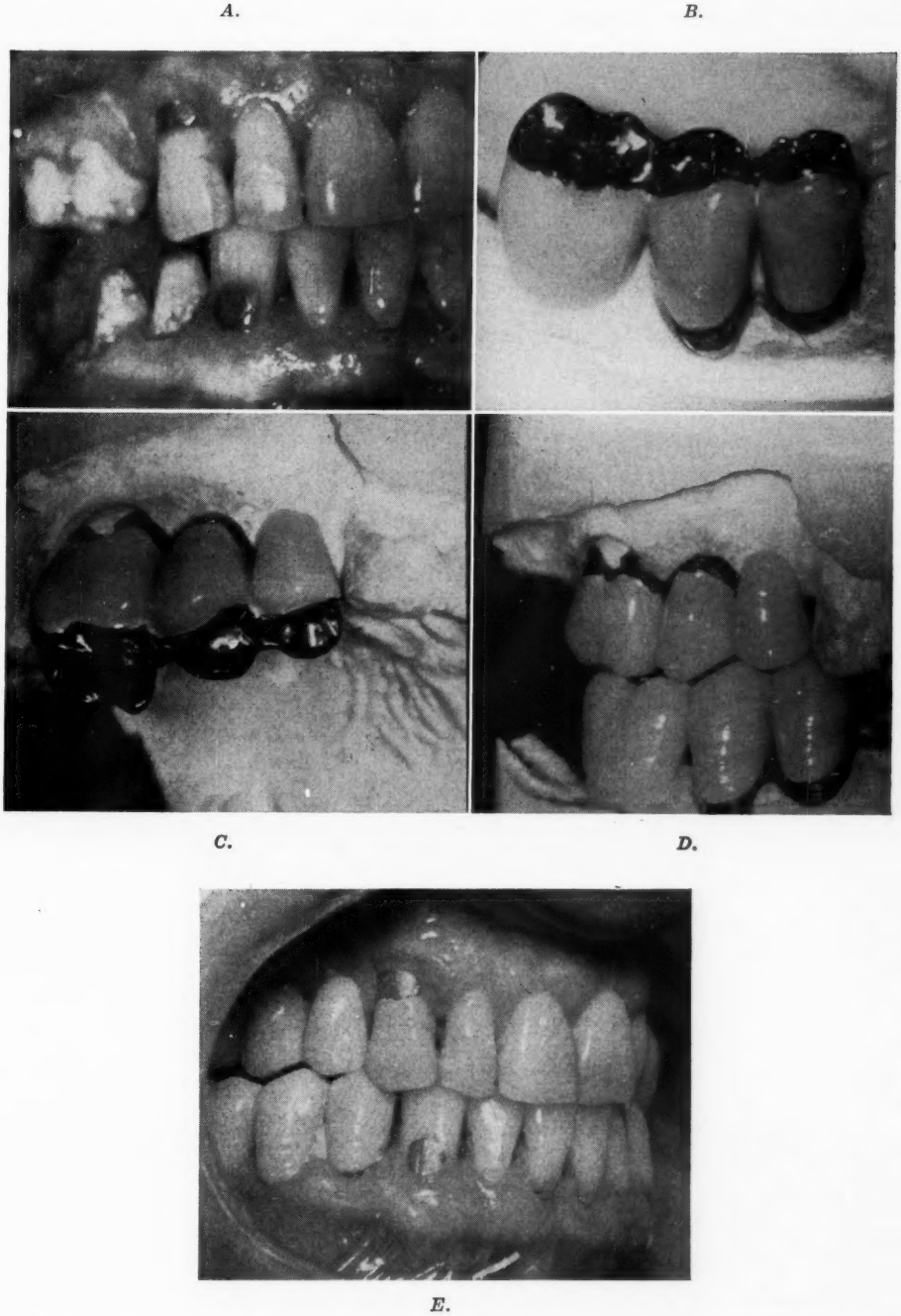
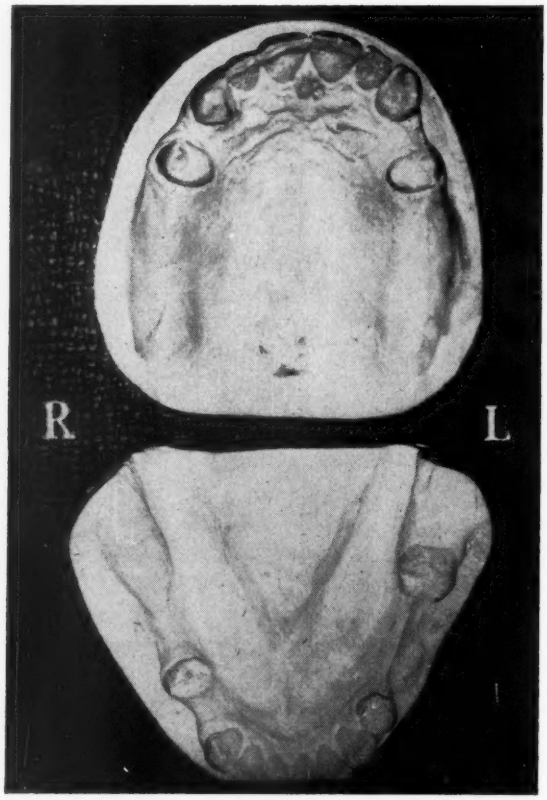


Fig. 9.—Restoration of a unilateral occlusion by means of the cantilever principle. *A*, Shoulderless full crown preparations on the mandibular first and second bicuspids. Similar preparations on the maxillary first molar and second bicsupid. *B*, The first mandibular molar pontic is cantilevered posteriorly from double attachments on the two mandibular bicuspid teeth. *C*, The first maxillary bicuspid pontic is cantilevered anteriorly from double attachments on the maxillary first molar and second bicuspid teeth. *D*, The completed restorations on the working casts. *E*, The completed restorations in the mouth.

crowns were placed on the upper right cuspid and second bicuspid teeth, and the first bicuspid was supplied with a pontic, and a bicuspid pontic was cantilevered posteriorly. On the left side acrylic resin veneer gold crowns were placed on the upper left cuspid and second bicuspid teeth, supplying the first bicuspid with a pontic. Acrylic resin veneer gold crowns were placed in the form of double attachments on the lower right cuspid and first bicuspid teeth, and a bicuspid pontic was cantilevered posteriorly.*

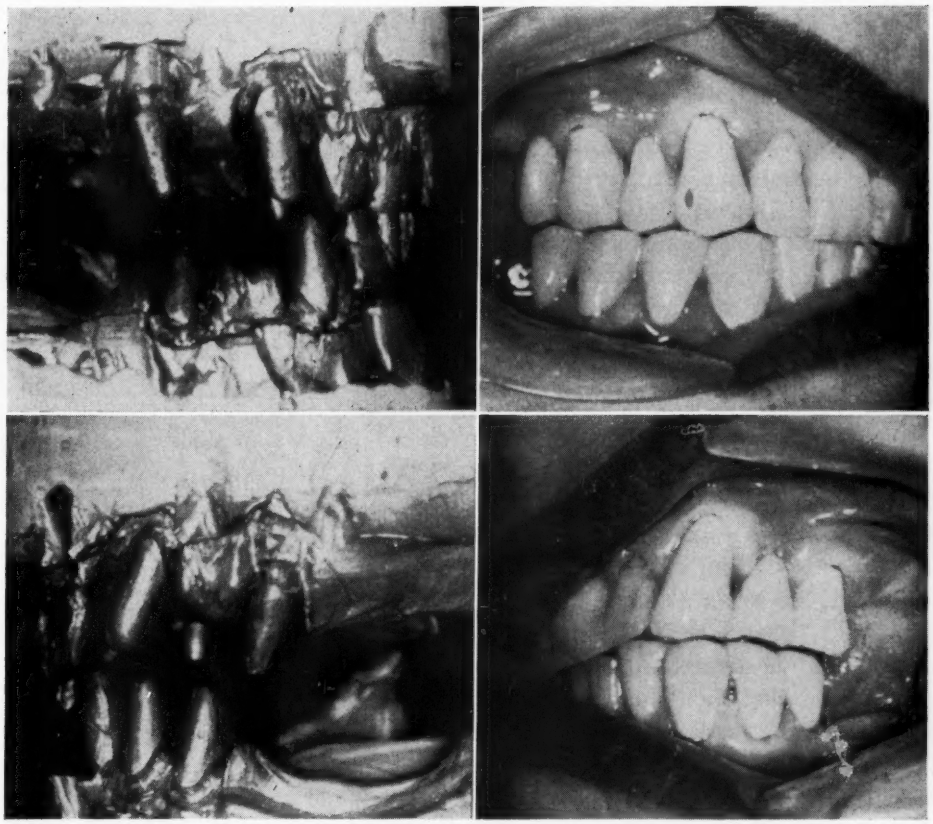


A.

Fig. 10.—Removable partial dentures were not acceptable to the patient. *A*, Study casts reveal all molar teeth to be missing with the exception of a pathologically involved mandibular left second molar. *B*, Shoulderless full crown preparations on the lower right cuspid, lower right second bicuspid, upper right cuspid, and upper right second bicuspid teeth. *C*, Acrylic resin veneer gold crowns were placed on the upper right cuspid and upper right second bicuspid teeth supplying the first bicuspid pontic and cantilevering a bicuspid pontic posteriorly. Acrylic resin veneer gold crowns were placed on the lower right cuspid and lower right second bicuspid teeth supplying the first bicuspid pontic and cantilevering a bicuspid pontic posteriorly. *D*, Shoulderless full crown preparations on the lower left cuspid, lower left first bicuspid, upper left cuspid, and upper left second bicuspid teeth. *E*, Acrylic resin veneer gold crowns were placed on the upper left cuspid and upper left second bicuspid teeth supplying a first bicuspid pontic. Acrylic resin veneer gold crowns were placed on the lower left cuspid and lower left bicuspid teeth cantilevering a second bicuspid pontic posteriorly. *F*, the completed restorations in the mouth.

*Abrams, I.: Personal communication.

B. *C.*



D. *E.*

F.

Fig. 10,B—F. *(For legend, see opposite page.)*

CONCLUSIONS

1. Cantilever bridges can be made so that their environmental influences will be completely physiologic.

2. The cantilever bridge can be used successfully either anteriorly or posteriorly, if favorable clinical conditions are present.

3. Application of the cantilever principle in posterior sections will, in effect, act as a neutralizing force against the anterior component of force, thus reducing the ever present tendency for a forward tooth movement.

4. Forces of stress exerted in the first molar region are usually heavy; however, as they progress posteriorly their magnitude is decreased. Since first molar teeth offer the greatest area of periodontal attachment, and frequently are favorable clinically, there should be no hesitation to use this tooth for the application of the cantilever principle.

5. Pontics should be reduced in size as much as possible consistent with morphologic requirements. Occlusal reduction should be in a mesiodistal and buccolingual direction to the extent of at least one third. The occlusal surfaces of these pontics must be exceedingly well defined, and capable of dismemberment of food with the least expenditure of muscular effort, and hence with but little pressure upon the underlying mucosa.

6. There is not as much need for complete occlusal restoration as previously thought. Reduced or limited restoration is both desirable and more acceptable. The application of the cantilever principle seems to be in keeping with this concept.

7. After insertion of cantilever bridges, occlusal balance must be present. The presence of a negative occlusion will permit a bolus of food to act as an additional pressure upon the bridge. A positive occlusion will produce trauma in some degree. If either of these conditions exists, and a balance is not present, failure may occur.

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6. Chalfin, A: Artist's drawing, Fig. 8.

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A BRIDGEMETER FOR ABUTMENT PREPARATIONS

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THERE HAS BEEN A need for a precise instrument in paralleling abutment preparations when cutting teeth for fixed and precision bridgework. Such an instrument must be simple to use, lack bulk, and be easily adapted to various tooth inclinations and to variable levels of occlusal surfaces of the abutment teeth. It should be usable as a paralleling guide during preparation of the teeth, and for verification of the alignment of the completed preparations. The object of this article is to describe an instrument which has aided me materially in this work.

The paralleling instruments which are available have not been successful in meeting the requirements of such instruments because of their lack of flexibility in reaching areas of the teeth that are not on the same occlusal plane, and which are tilted in their axial relations. The bar and tube parallelmeter is awkward to use and lacks flexibility of adjustment to varying distances between teeth and to the gingival margins of the individual tooth surfaces (Fig. 1).

The instrument to be described overcomes these objections, and more than two paralleling pins may be used so that multiple abutments can be aligned when necessary. With this instrument, opposing surfaces of the cavity walls of one abutment may be checked for parallelism, and mandrels for precision attachment boxes may be placed in the instrument so that space for these receptacles may be accurately cut into the abutment teeth. This minimizes the cutting away of tooth substance and can prevent complications in placing the female parts of the attachments in the abutment castings later.

DESIGN OF THE INSTRUMENT

The instrument is a thin rectangular stainless steel bar (about 4 inches long) with a knurled finger grip (Fig. 2). The bar has two small hinged segments at the working end and six parallel holes at various distances from each other. These holes accommodate stiff stainless steel pins of 21 gauge or 0.028, which are held in the holes by spring pressure. These pins may be easily placed in the holes that seem best suited to match the approximate distance between bridge abutments. One pin is always placed in a hole in the end hinged section. The distance between the pins should be slightly greater than the span between the teeth when the instrument is fully extended. This allows the hinges to be flexed so the pin

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Read before the section on Partial Prosthodontics, Fixed, at the annual meeting of the American Dental Association, San Francisco, Calif., October, 1955.

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Received for publication April 13, 1956.

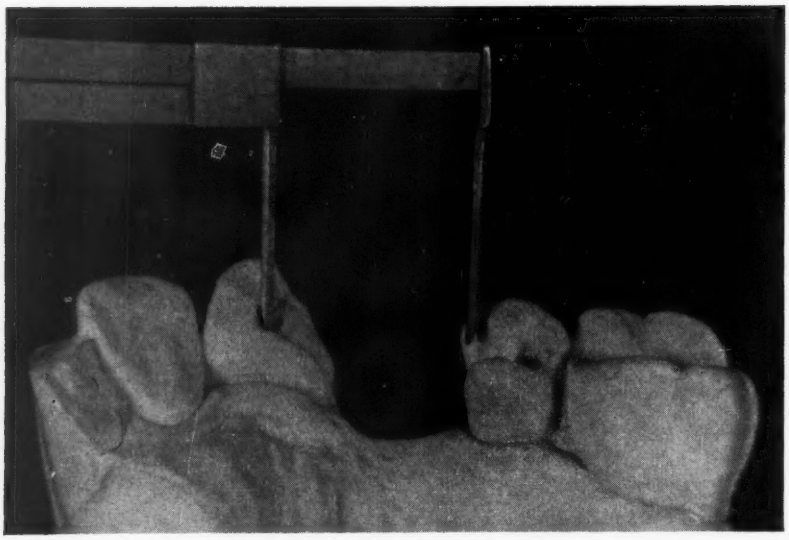


Fig. 1.—An old style bridgemeter. It is impossible to align the pinhole in the cuspid and the proximal wall of the bicuspid preparation.

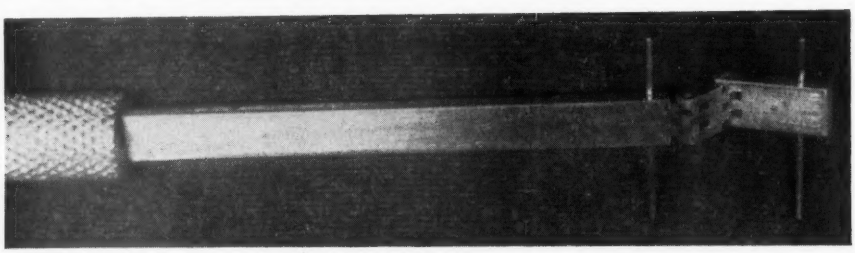


Fig. 2.—The new bridgemeter. Note the holes for additional pins or for varying the distance between the pins.

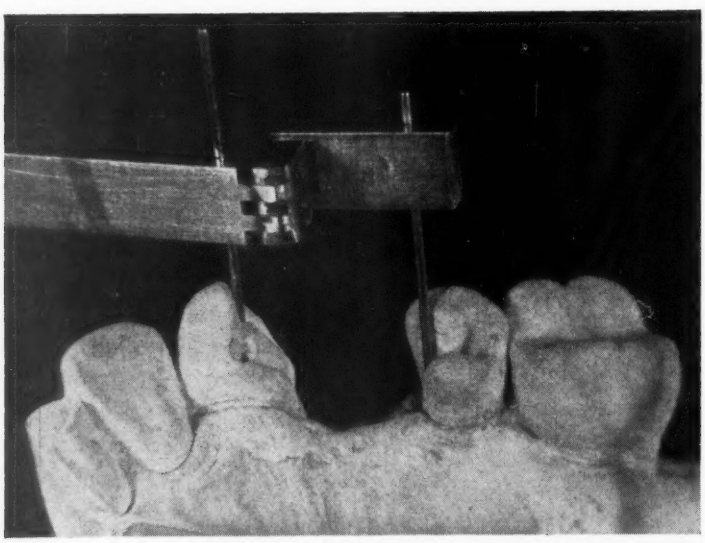


Fig. 3.—Aligning the pinhole in the cuspid to the proximal wall of a bicuspid preparation.

positions can be adjusted easily and accurately to the abutment surfaces. Each pin may then be pushed up or down so that it will extend to the gingival margin of the tooth surface that is being cut (Fig. 3).

USE WITH PINLEDGE PREPARATIONS

When cutting pinholes in teeth at various levels, the pins of the instrument may be easily shortened or lengthened to contact the involved cavity preparations. The instrument allows the pins to be adjusted quickly to the distance between abutment teeth, and the pins are easily shortened or lengthened to extend to the gingival margins or incisal pinholes of each tooth surface that is being cut (Fig. 4).

USE WITH PRECISION ATTACHMENTS

The instrument is valuable for aligning the box forms in teeth that are to carry precision attachments. For this purpose mandrels are attached to the pins. These mandrels are slightly wider than the female attachment that is to be placed in the specific tooth. For example, if a molar and a cuspid are abutments, the mandrels, carried on pins, are placed in the bridgemeter. As the box forms are cut, they are aligned and sized to accommodate the mandrels. In this way the box forms are paralleled and, at the same time, cut to the precise width and depth to accommodate the attachment. Later, the female attachment may be accurately positioned within the tooth contour to take advantage of the full length of the attachment, and to avoid a protruded gingival margin on the abutment casting (Fig. 5).

The position of the attachment on a cuspid or bicuspid abutment can be judged with the mandrel so that the box form will not be too close to the labial or buccal surface of the tooth. This can be important to prevent mechanical difficulty in placing the adjoining pontic.

THE SEMIPRECISION OR NEUROHR ATTACHMENT

These attachments can be used when the abutment teeth are short and require a lingual clasp arm for retention of a removable prosthesis. In distal-extension partial dentures, the Neurohr attachment acts suitably as a stress breaker if it is placed properly in the abutment teeth.[1] The bridgemeter can be useful in these cases, both in the mouth for cutting the box forms and in the laboratory to properly align the receptacles or Neurohr platinum "shoes" in the wax patterns (Fig. 6).

USE WITH CLASP REMOVABLE PROSTHESIS

The bridgemeter may be used against the contours of proximal surfaces of abutment teeth to guide the reduction of excessive *proximal* contours and prevent large spaces from occurring between the bridge strut and the abutment tooth below the height of proximal contour (Fig. 7).

Occasionally, a malaligned tooth, usually molar or bicuspid, may need to have a buccal or lingual bulge of contour removed for more satisfactory clasping (Fig. 8). The bridgemeter will serve as a guide for the modification of these teeth. In simple,

Fig. 4.

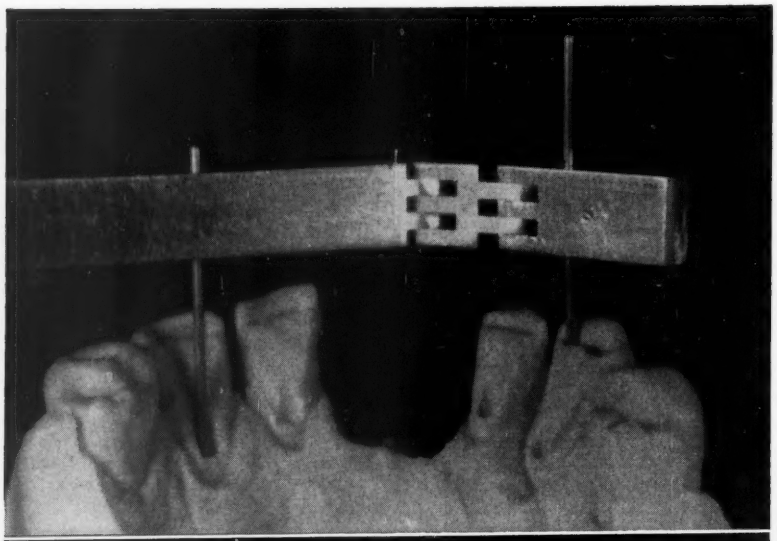
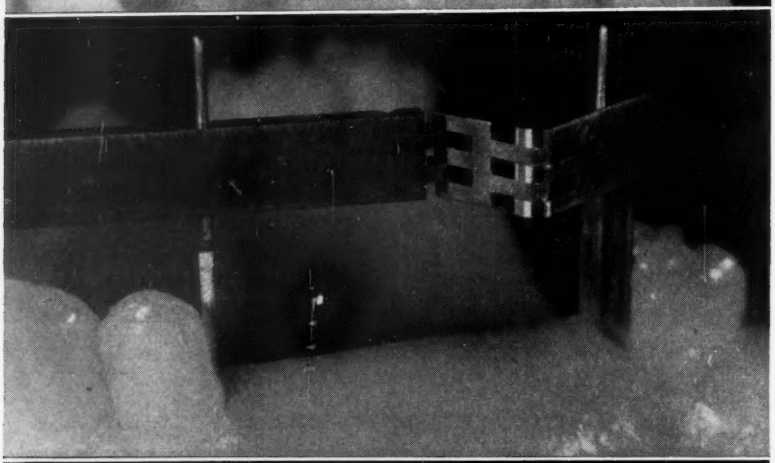


Fig. 5.



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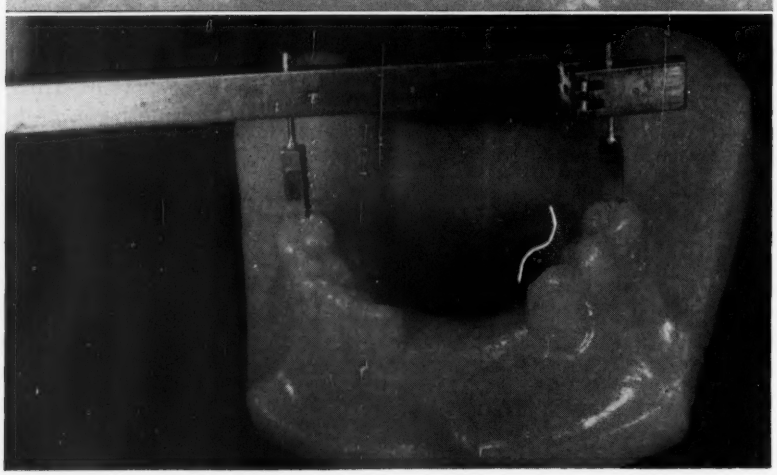

Fig. 4.—Aligning pinholes at different levels for a fixed bridge and splint.

Fig. 5.—The bridgemeter with a precision mandrel on a pin to align the box forms in cuspid and molar preparations.

Fig. 6.—Mandrels and platinum "shoes" for Neurohr attachments being aligned on lower bicuspids.

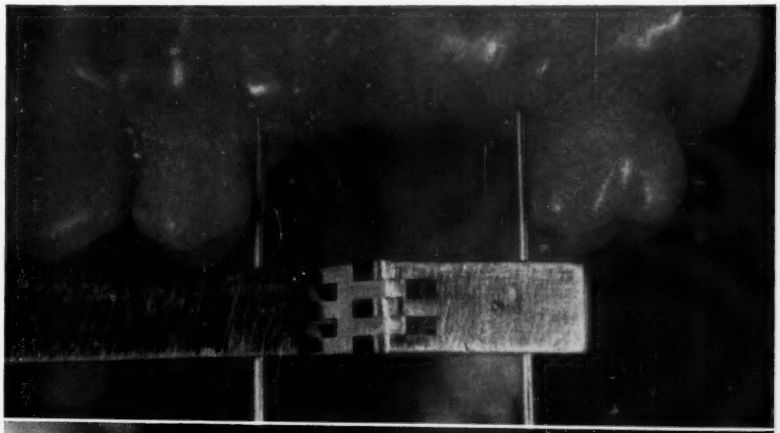

Fig. 7.

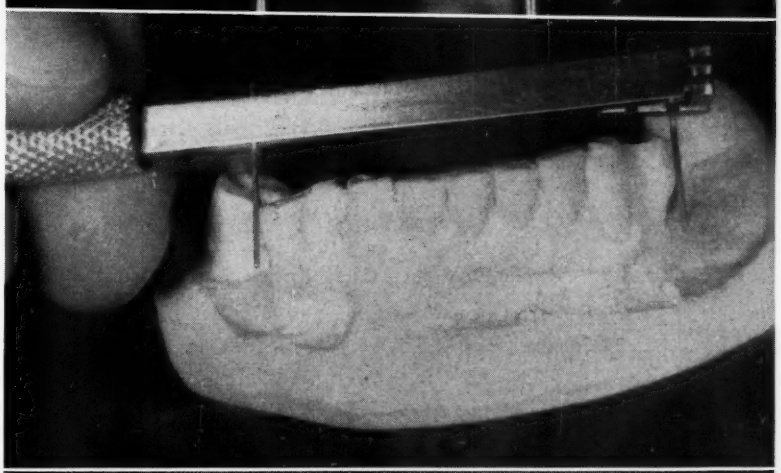

Fig. 8.

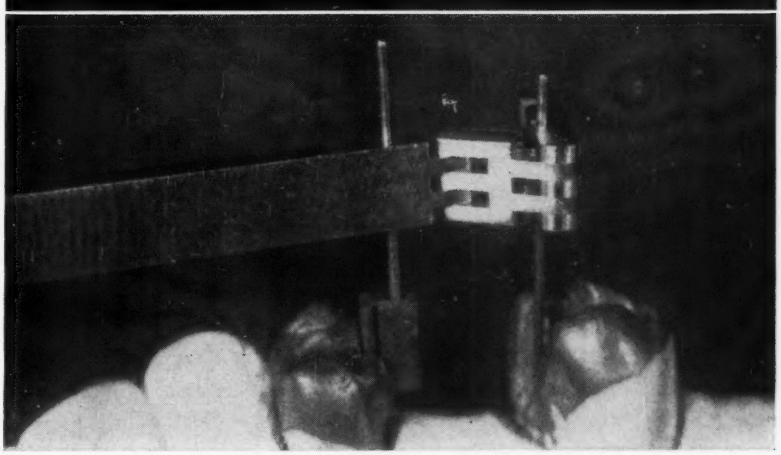

Fig. 9.

Fig. 7.—The bridgemeter adjusted to determine the proximal contours of teeth to be clasped.
Fig. 8.—The bridgemeter adjusted to show excessive buccal contours on teeth to be clasped.
Fig. 9.—A precision rest in the bicuspid wax pattern being aligned to a proximal preparation in a molar.

unilateral clasp-type removable dentures, the bridgemeter may be used on the cast for the initial or tentative surveying, to determine the path of insertion of the restoration.

PRECISION RESTS IN FIXED BRIDGEWORK

Sometimes it is desirable to use a deep precision rest in one fixed-bridge abutment casting. This rest must then be parallel to the line of insertion of the other abutment casting. It is reasonably simple to insure this by waxing the rest mandrel to one pin of the bridgemeter (when waxing the abutment patterns in the laboratory), and with the regular pin of the bridgemeter resting against the wall of the other abutment preparation, the rest may be aligned to this cavity wall to assure parallelism (Fig. 9).

CONCLUSION

The small size, flexibility, and simplicity of the instrument described facilitate the construction of fixed and removable bridgework. The dentist will know that the preparations are well made and are parallel before the impressions, casts, and castings are completed. He can then proceed with these laboratory details, confident that the bridge or fixed splint will fit the teeth without difficulty.

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IMPRESSIONS FOR TEMPORARY ACRYLIC RESIN JACKET CROWNS

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THE USUAL WAY TO make a temporary quick-curing acrylic resin jacket crown is to first secure an irreversible hydrocolloid impression. This impression is then used to reproduce the anatomy of the tooth in acrylic resin, either by placing the mixed resin in the impression and re-seating the impression in the patient's mouth, or by painting the resin into the impression to form a shell which is then used in the mouth. It is often convenient to make the impression at one visit, and to use it at a subsequent visit. It is certainly more convenient, and time-saving as well, if the impression can be used repeatedly over a period of time as is necessary to complete the preparation of multiple teeth for jacket crowns. This is difficult when the impression material is irreversible hydrocolloid, for its preservation always presents problems, and for accuracy it should be used within one-half hour.

The problem in securing an impression for a temporary acrylic resin jacket crown is to find an impression material which is accurate and yet elastic so that it can be reseated in the mouth as many times as necessary, and which requires no special care, and has sufficient dimensional stability so that it can be left around the office for extended periods of time.

IMPRESSION

A tray is selected which is large enough to cover the teeth to be prepared and at least one tooth on either side of them. High heat modeling plastic is preferable so there will be a minimum of distortion of the impression at room temperatures. The modeling plastic is softened, placed in the tray, and inserted in the patient's mouth. The tray is held in position for about three minutes and then withdrawn (Fig. 1). Only after withdrawal is the impression chilled. The impression is reinserted in the mouth to make certain that it seats. If it does not, the undercuts are relieved until the impression can be seated and withdrawn without difficulty.

Holes are drilled into the modeling plastic with a No. 8 round bur (Fig. 2). These holes are undercut so that a rubber impression material will be securely gripped and held. A large number of holes is essential for this purpose. However, some of the adhesives supplied with the rubber impression materials can hold the impression material to the modeling plastic adequately.

Received for publication May 7, 1956.

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Fig. 1.—A high heat modeling plastic impression of teeth to be prepared for crowns.

Fig. 2.—A modeling plastic tray prepared with retention holes.

Fig. 3.—A rubber base impression made in a modeling plastic tray.

A rubber impression material is mixed in accordance with the manufacturer's directions, and placed in the modeling plastic tray. This material must be used promptly or it will thicken and become distorted upon removal. The tray is seated so there is a thickness of no more than 3 or 4 mm. of rubber impression material. After the rubber material has set, the impression is withdrawn (Fig. 3). This impression is used for the fabrication of temporary quick-curing acrylic resin jacket crowns.

The rubber impression materials have been found[1-3] to have the following properties which are essential to the solution of the problems of adequate impressions for temporary crowns. They have (1) an accuracy equivalent to that of any typical hydrocolloid impression material, (2) an excellent dimensional stability (Skinner and Cooper[1] found the impression still accurate after standing for eight weeks), and (3) no special care is necessary for handling the impressions; however, heat will distort the modeling plastic tray.

SUMMARY

A method for securing an impression for quick-curing temporary acrylic resin jacket crowns has been described. The impression is simple to obtain, needs no special care, has excellent dimensional stability, and has the accuracy of any typical hydrocolloid impression.

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A FULL CAST CROWN TECHNIQUE

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THE FULL CAST CROWN is one of our most useful restorations. In operative dentistry it usually constitutes the final attempt to preserve the tooth, while in prosthetic dentistry it provides maximum retention and strength. When used to restore or improve occlusal function, the full cast crown provides the most latitude in reshaping tooth form. It is a conservative restoration because it does not require extensive dentine removal. In many instances, the tooth can be prepared in such a manner that the cast crown can almost be considered a metallic substitute for the enamel. In addition, it can be made a very durable and trouble-free restoration. Unfortunately, especially in view of its broad usefulness, its production involves some of the most intricate and perplexing problems in dentistry.

The aim of this article is to present a comprehensive analysis of full cast crown construction, together with practical techniques and various means of circumventing the most common troublesome involvements.

THE PRELIMINARY EXAMINATION

The preliminary oral examination should be made with roentgenograms and study casts of the dentition. Roentgenograms are invaluable because they reveal the general condition of the periodontal membrane and the alveolar bone. The location of the pulp should be noted, especially in young patients or when extensive caries or deep restorations are present. Roentgenograms should also be used as an aid in determining the nature of the interproximal area. In cases of destroyed contact points due to caries, the teeth sometimes migrate so as to place their roots in close proximity to each other. A similar condition may also exist in cases of irregularity. Therefore, in conjunction with the roentgenograms, the passing of a curved explorer gingival to the contact points is utilized to determine the mesiodistal width of the embrasure area. An examination of this area is important because the location and direction of the initial diamond saw cut from the occlusal surface of a molar toward the gingivae is influenced and determined by the size and shape of this region.

The condition of the gingival tissue should be examined, and efforts made to reduce any inflammation before the actual preparation is started. In almost

Read before the Wisconsin State Dental Society, April 11, 1956.
Received for publication April 17, 1956.
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all cases this involves instruction in the proper use of a suitable toothbrush and interdental massage.

The preliminary examination should also include a study of the occlusion of the entire dentition. Any required equilibration should be accomplished before an individual restoration is commenced.

The prevalence of caries in any given dentition may influence and determine the type of restoration to be used. When examination reveals that the patient is the victim of extensive caries, a crown of full coverage is often indicated.

After the coronal portion of the tooth has been examined and it has been determined that the full crown is the restoration of choice, the surrounding gingival crevice should be explored with a beaver-tail burnisher or a blunt dental explorer to determine the depth of the gingival crevice. This exploration will reveal that the gingival crevice may vary from no measurable depth (although this is the ideal, it is found in only a very small percentage of cases) to extreme depths such as is found in advanced cases of periodontoclasia. A mental note of this variation should be made, because it may determine the location of the subgingival margin. This variation in the depth of the gingival crevice precludes the arbitrary setting of all crown margins at a definite distance under the gingival tissue.

Frequently, examination of the buccal and lingual surfaces of a molar crown will reveal that the enamel is intact and that the gingival crevice is scant. With such a circumstance, it is advisable to place the margin a distance (about 2 mm.) from the gingivae on a self-cleansing area. The margin should never be terminated in the stagnant area formed by the thickness of the gingivae upon the tooth surface, for this surface is most vulnerable to caries. Should the enamel or cementum of this surface be attacked by caries at a subsequent date, an individual restoration may be made without disturbing the crown. If the gingivae and the supporting tissues of the tooth have receded to any extent, it is usually advisable to terminate the crown margin away from the gingivae. This is recommended, because, in such a case, an unusually large amount of tooth structure removal is necessary to produce a sufficiently tapered preparation. A feather-edged margin should be used whenever possible, because the type of preparation utilizing this margin conserves tooth structure, which is especially important when geriodontics is considered.

If necessitated by active caries or old restorations, portions of the gingival shoulder can remain as such, but the deliberate creation of a circumscribed shoulder in sound tooth structure for a complete gold crown is wasteful and destructive. When amalgam restorations are present, they may be incorporated in the preparation if they are intact and show no evidence of adjacent caries. However, if there is evidence of faulty adjacent tooth structure, old amalgam restorations should be removed, and then either a conventional proximal inlay cavity formed, or a cement base used to eliminate undercuts. If the undercut area is distant from the pulp, the cement may be mixed to a thick consistency to hasten the setting. The cement may be forced to place with an instrument which has been dipped in alcohol to prevent adhesion. If a gold inlay is present, it should be cut through the occlusal surface with a bur after which the segments may be removed.

In older patients, the condition known as senile caries is frequently encountered. Here the gingivae have receded and the exposed cementum and dentine have become attacked by a condition which destroys the tooth to the extent that the dentine may be severed piecemeal with a spoon excavator. The enamel may or may not be subject to true carious destruction at this time. It is not unusual to see this condition encircling the entire tooth between the gingivae and the enamel. This condition is best managed by an onlay preparation conjoined with slice preparations which extend under the gingivae on the mesial and distal surfaces. If the buccal and lingual surfaces are involved, they can subsequently be restored by a separate operative procedure.

In cases where Class V erosion or caries is present, the procedure is dependent upon the extent to which this condition has progressed. If the cavity or erosion is shallow, it may be incorporated in the full crown preparation. If the destruction has considerable depth, it is advisable to conserve tooth structure by preparing and filling this area with cement before proceeding with the usual preparation. Obviously, this cement filling must be covered subsequently by a prolongation of the crown margin. Where the destruction and recession has progressed far gingivally upon the root, it is sometimes advisable to utilize a gold inlay, an amalgam or a gold foil filling in this area. This restoration should extend well under the gingivae and should be finished before the full crown preparation is started. This procedure will then permit a preparation of the proper taper without necessitating excessive reduction of tooth structure. The occlusal portion of the individual restoration is chamfered in such a manner that the metal of the full crown overlays the occlusal portion of this buccal restoration. It is possible with this combination to make a more accurate adaptation inasmuch as it eliminates the necessity for a long and uneven prolongation of the gold crown, which presents a more difficult problem in every step of the full crown fabrication.

THE REMOVAL OF TISSUE FOR ACCESS

Frequently the operator must produce a cast crown upon a molar that has active caries or old amalgam restorations extending far under the gingivae. In these cases, the overlaying gum tissue is always pathologic. In contending with this problem, it is advantageous first to prepare the tooth exclusive of this area, and, as a last step, to remove the interfering tissue with a small pair of curved shears, a Bard-Parker lance, or a Ward's surgical periodontal instrument. This procedure precludes the hemorrhage thus created from interfering during the major part of the tooth preparation. The line of incision is usually determined by the depth of the gingival crevice. This depth can be defined by the use of a millimeter gauge or be automatically registered by using a Crane Kaplan marker.

A clear area of cementum, about 1 mm. in width, should be visible at the gingival margin of the preparation. In some rare instances, the gingival margin is found to extend to the periodontal attachment. In such cases, it may be necessary to remove an arc of the alveolar bone in order to provide this millimeter of unblemished cementum.

Another difficult situation arises when a full cast crown is to be placed on an upper first molar having recession or caries on a lingual root which flares

out at such an angle that it follows approximately the curvature of the palate. This complicates not only the developing of the preparation but also the securing of the copper band impression. When it has been decided that a prolongation of the cast crown should cover this lingual root, the overlaying soft tissue should be removed in order to facilitate the preparation and impression making. During the cementing of the crown, if this tissue is allowed to remain, it is very likely to become impinged between the prepared root surface and the crown itself. This impinged tissue not only ruins a fine marginal adaptation, but it also alters the occlusion. In addition, the eventual dissolution of this impinged tissue leaves a space which allows for certain ingress of caries.

Surgery can be utilized to bare completely unerupted third molars to be used for abutments in either fixed or removable prosthesis (Fig. 1). When roentgenograms show that the impacted molar is in a usable position in the dental arch, the crown of the tooth is denuded of soft tissue, and arcs of the alveolar bone are removed, in order to extend approximately midway on the axial enamel

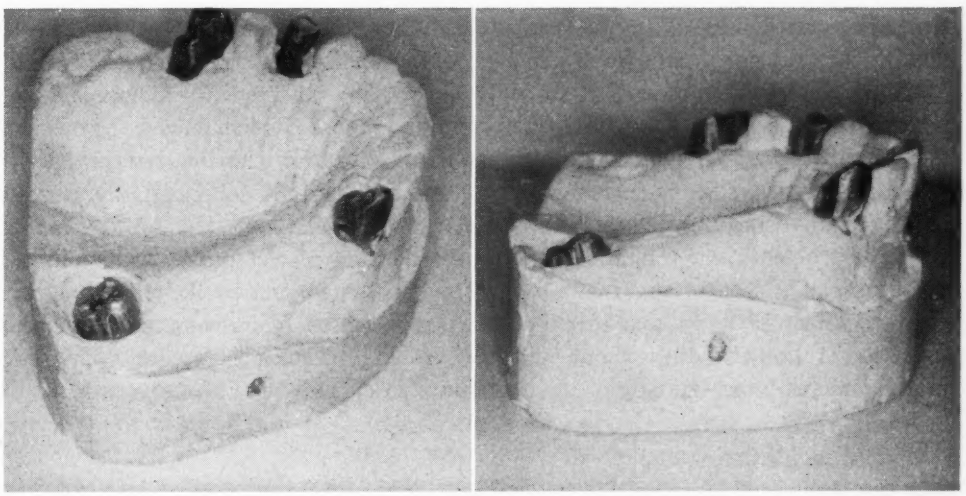


Fig. 1.—A partially erupted upper third molar prepared to be used in connection with a precision restoration.

of the crown. Because it is not necessary to remove any of the occlusal surface, this surface is penetrated by properly located posts for auxiliary retention. Minor surgery can facilitate and make possible the production of a durable restoration which would be otherwise impossible. The elimination of soft tissue can be performed without excessive postoperative distress or discomfort.

IMPRESSION FOR A COMPLETE CROWN PREPARATION

Before elastic impression materials were introduced, the technique of negative reproduction of a full crown preparation consisted of placing softened modeling compound within a copper band, and then forcing it to place over the preparation and into the subgingival area. It was then chilled and removed in toto. Accuracy

in the use of this method is impossible because of the undercuts created by the inherent constriction of the tooth existing beyond the subgingival margin of the preparation.

It is illogical and impractical to believe that we can secure an accurate impression of a preparation, where undercut areas are involved, with the uncompromising inflexibility of chilled modeling compound which will invariably rend apart before yielding to withdrawal. On the other hand, if the copper band impression is removed from the preparation before the impression material is thoroughly chilled, it is possible to pull it off the tooth without breaking. Upon examination it may appear acceptable, but this is merely an illusion. This method will produce only a distorted, warped, and imperfect impression.

A negative reproduction possessing accuracy could be made if the chilled modeling compound would extend only to the margin. It is a technical impossibility to pin-point the crest in the impression in its entire circumference within the blind cul-de-sac of the gingival crevice.

Attempts have been made to secure impressions by the use of a tight-fitting annealed copper band with the aim of excluding the modeling compound from flowing into the constricted areas on the tooth. The margin line would be formed by using the inner surface of the copper band, with the modeling compound extending only occlusally from this line. This method is a refinement. However, the gingival circumference does not conform to a true circle, but has inflections which permit the soft modeling compound to seep and flow between the copper band and the concavities of the gingival margin.

The problem created by the gingival constriction was recognized by the pioneer operators, and an effort was made to circumvent this enigma by the use of enamel cleavers which were designed to rip off the obstructing subgingival enamel in order to create a preparation without undercuts. The technical procedures involved in accomplishing this were destructive and impractical and were soon discarded.

ELASTIC MATERIALS

Since any material which becomes rigid and inflexible is unacceptable, we must choose from the hydrocolloids, the alginates, the rubberlike materials, Mizzy Trulastic or Dietrich's Elastic compound. Of these, I consider Dietrich's Elastic compound the most satisfactory for this technique. This compound is sufficiently rigid when chilled, and possesses enough body to sustain itself subsequent to removal from the preparation.

THE COPPER BANDS

The role that the copper band plays in the impression technique for complete crowns must be contemplated and analyzed before an accurate technique can be evolved. The circumference of the copper band for any given prepared tooth must be such that it will fit over the preparation and still project into the gingival crevice. An oversize band should not be used, since at least an arc of it will impinge upon the soft tissue, thereby causing a compression which forces the tissue tightly against the preparation surface, with the result that the impression is in-

complete. The use of an unannealed copper band is contraindicated since its resistance to change of form makes it impossible to fit the subgingival margin accurately. In addition, if a hard copper band with elastic material is forced to conform to the gingival margin, stresses with the copper are formed. Upon removal, the strain is released and the softer elastic material is compelled to assume the false shape that the copper dictates. This results in an impression which is clamped in a distorted and warped form.

I recommend the use of a soft copper band, which is easy to shape, since merely exerting force when it is on the preparation will cause it to assume and retain the desired form. The hard copper band is rendered dead soft by heating it to a dull red color and quenching in alcohol. It should not be overheated because this tends to form scales on the surface of the metal.

However, the use of this soft copper band is only the first step in solving the problem. As noted before, the space between the copper cylinder and the gingival margin must necessarily be very small, since the band must project into the gingival crevice. This restricted space seriously limits the value of an elastic impression material which requires unrestricted bulk to enable it to spontaneously return to its former size and shape. If the elastic impression material is placed in a soft copper band and forced over the preparation, some of the material flows into the constricted area beyond the margin. When the copper band and the chilled elastic impression are withdrawn simultaneously, the copper must yield to this internal force. The soft band, which has assumed a new false static shape, subdues and holds the weaker confined elastic material in this untrue and inaccurate form.

Since it is imperative that a copper band be used to restrict and convey the impression material over the preparation, and inasmuch as the copper band precludes any possibility of withdrawing an undistorted or unwarped impression, a technique must be devised for using a copper band as a matrix, but with the restraining power of the copper circle broken before the impression is removed. Based on this premise, a technique evolved which resulted in extreme accuracy, no unnecessary surgery or preparatory packing for exposure of the gingival margin, and with consistent acceptable impressions within a practical scope.

A SATISFACTORY COPPER BAND TECHNIQUE

The technique calls for three major variations: (1) the special preparation of a 36 gauge copper cylinder as a matrix, (2) the placing of this matrix over the preparation and impressing the softened elastic material into the matrix, (3) the disjoining of the copper band after the impression material is chilled, but before the impression is withdrawn from the preparation.

In selecting the correct size of band, it is important that it should fit snugly, but not so tight that the cylinder is flared out in passing over the gingival margin. Selection of the correct size may require several attempts because the actual fit can be verified only after the band is festooned to conform to the gingival curvature.

In order to scallop the gingival curvature neatly, the curved crown and bridge scissors can be improved so as to allow the cutting of arcs without crimping the band. This can be accomplished quickly by the use of a half-inch heatless stone. The blade of the scissors that functions inside of the copper tube should be reduced from the back toward the cutting edge and then rounded (see Fig. 2).

The surface of the band designated as the mesial should be marked near the occlusal edge. This mark now makes it possible to replace the band upon the preparation repeatedly without confusion.

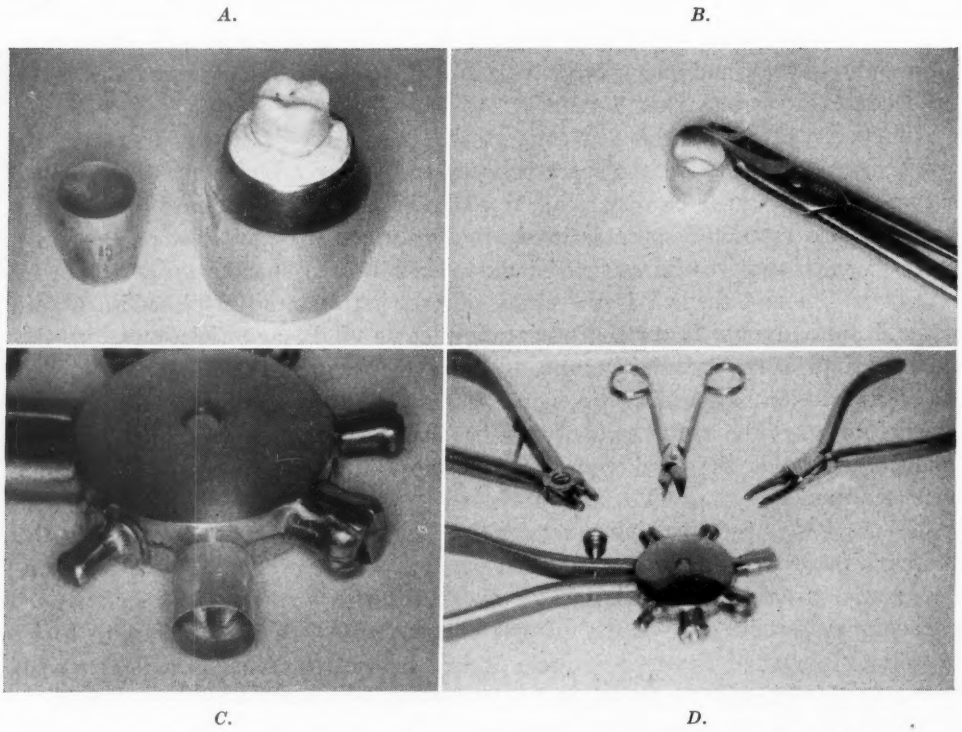


Fig. 2.—*A*, A copper band selected for a preparation. *B*, Modified crown and bridge scissors are used to festoon the copper band. *C*, A protruder with a copper band. (It can be inserted either from the gingival or occlusal end of the copper band.) *D*, The instruments used to shape a copper band: Top row, from left to right, S. S. White contouring plier No. 138, Curved crown and bridge scissors with a reshaped blade, S. S. White contouring plier No. 114. Below, copper band protruder (Densco).

The curvature of the gingival line should be scrutinized to furnish a mental picture which facilitates the festooning of the copper band. When the band conforms to the general curvature, it is seated within the gingival crevice. The position of the preparation in relation to the inner surface of the band should be observed. The band should be trimmed in such a manner that when it is in position, a space approximately equidistant should surround the preparation. Maintaining this space, the gingival edge of the band should be trimmed until it contacts as much of the terminal flecture of the gingival crevice as possible. An uneven contact can be recognized by rocking with repeated tipping movements (Fig. 2).

The copper band protruder, which has been refashioned from an old shell crown former, is inserted and the band expanded buccolingually, and also mesiodistally if the adjacent tooth, or teeth, permit. This provides a space for the

impression material to engulf the preparation and flow into the subgingival area. When the adjacent teeth are in close proximity at the gingival line, an inlay box form with a gingival bevel must be fashioned in the preparation. In this instance, only the buccal and lingual surfaces of the band are protruded, leaving the mesial and distal surfaces of the band straight so they can be passed over the gingival wall. The box-form must be produced in the preparation in order to create a passageway for the impression material. Inasmuch as the internal expansion by the protruder must be exerted at right angles to the long axis of the copper cylinder, the bulging must be formed distant from the final gingival margin of the band. Therefore, the area of extrusion is usually governed by the shorter lingual

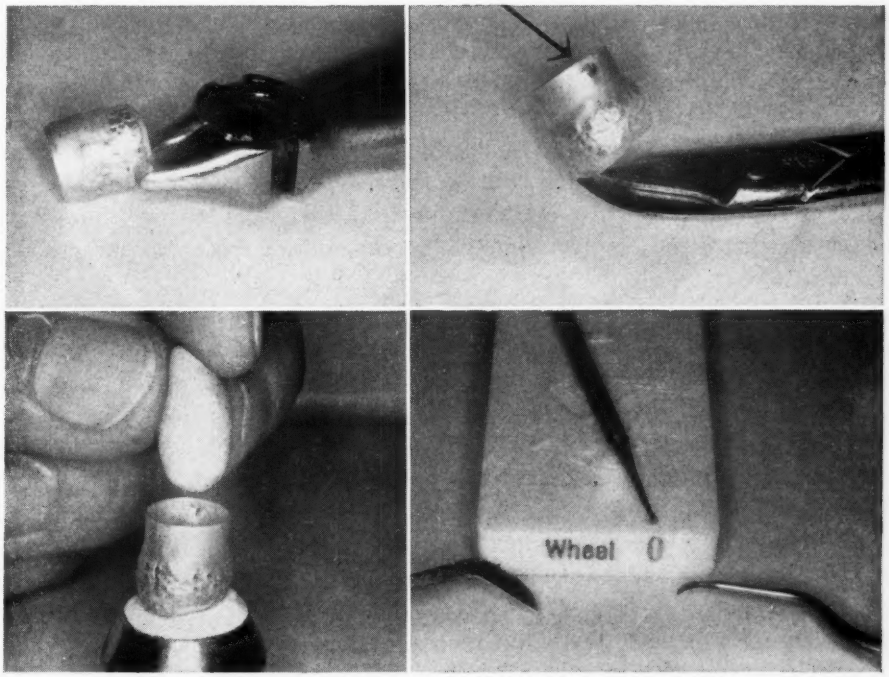


Fig. 3.—*A*, The use of a No. 138 S. S. White contouring plier. *B*, Arrow points to a mark which identifies the mesial surface of the copper band. The scissors are used to cut slits through the buccal and lingual gingival rim of the band. *C*, A bulged copper band over the preparation, with softened elastic impression material ready for insertion. *D*, A gold knife sometimes used to disjoin copper band. Wheel bur No. 0 used for the same purpose. The small hook instrument used for removing the impression.

length of the preparation. The festooning of the gingival periphery will usually produce a scallop or scallops to overlay the buccal curvature which may be exaggerated by gingival caries or recession. These projections cannot be bulged with the protruder, since this method of expansion must be furnished with a reciprocating wall in order to function. Therefore, these scalloped areas are bulged by compression. For this purpose a No. 138 S.S. White contouring plier should be reshaped from a ball to a more pear-shaped form with the base of the pear toward the axis of the plier (Fig. 3). The reshaped peen will now create a deeper

imprint near this base and will produce a more definite angle of embossment. When the fit and adjustment of the band is precise, the bulging within a prescribed area is accomplished by compressing the copper between the anvil and the peen of the plier (Fig. 3,*A*). This prescribed area should extend from the crest of the stretched protuberance to within 1 mm. of the gingival edge. This embossing should turn this millimeter of copper inward at about a 45° angle. By impressing a series of bosses, one slightly overlapping the other, a continuous protruded area is produced. The margin rim of the copper band which has been altered by this process must be returned to the preparation and gently forced over the gingival margin to reshape it. It should then be removed and examined to determine if the end of the copper band has been curled inward during its passage over the gingival margin. If an edge has been bent, it must be reformed with a No. 114 S.S. White plier until it slips over the entire preparation. The process of embossing near the gingival edge alters the circumference of the band only slightly. It has a tendency to lessen the circumference to the extent that, occasionally, it will not pass over the gingival margin if it is forced on in a direct line with the long axis of the preparation. In most cases it is possible to tip the band slightly bucally or lingually, and allow this side to pass into the constricted area beyond the margin. After this, it is then tipped in the opposite direction, thereby allowing it to slip over the other crest of the gingival margin. A reversal of this procedure should be used to remove it.

The occlusal edge of the band should extend about 3/16 inch beyond the occlusal surface of the preparation. The shortening of the band is frequently necessary to provide sufficient interocclusal space for the introduction of the impression material into the copper matrix.

On both the buccal and lingual surfaces of the band, slits about a millimeter long (through the unbossed rim at the gingival end) are cut with scissors. The edges of the slits which are curled by the scissors are reformed with a No. 114 S.S. White plier to produce a continuous almost invisible line. The slits allow the compressed air to escape when the softened impression material is being forced into the confines of the copper matrix. Without these slits, it is possible to create an airtight compartment, sealed by the 45° crimp of the copper matrix against the soft adaptable gingival tissue. When this condition exists, the compression of air precludes any possibility of securing a complete impression, since the air must be dissipated as fast as the impression material is made to flow into the matrix. Inasmuch as the rim of unembossed copper at the gingival end of the matrix is difficult to tear or cut, this buccal slit also serves as the terminal of the rending line. Because the buccal slit may be obscured by soft tissue or impression material, a definite line must be scratched on the surface of the copper to lead to its location.

IMPRESSION

The prepared band is placed on the preparation. A one-inch ribbon of softened impression material is folded upon itself to eliminate minute wrinkles, and is rolled between the thumb and the index finger until the diameter of the plug is slightly

less than the aperture of the copper matrix. It is now quickly compressed over the preparation and into the confines of the matrix. Continued steady pressure should be applied until the rim of the copper matrix can be felt by the finger. The pressure is then released, and excess material which has escaped is folded back into the center of the rim of copper, and again steady pressure is applied. Dietrich's impression compound is sufficiently fluid when used in this manner to move into the finest recess of the space created by the specially formed matrix. With continued steady pressure applied to the impression, it should be chilled with water at 45° F. for several minutes. It has been found that water of at least this temperature must be used in order to produce accurate impressions. The Vacudent method of water removal from the oral cavity during the chilling is especially advantageous, inasmuch as it keeps the surplus water in the oral cavity to a minimum. This reduces the discomfort produced by the cold water flowing on the remaining teeth. Because of the discomfort generated by this cold water, everything being equal, the maxillary teeth should be operated upon first, in order to eliminate the flowing of the cold water upon newly cemented mandibular restorations. After chilling, any excess impression material on the occlusal surface is removed from the band, and the copper mix is disjoined by the use of a No. 0 wheel bur. Because of the small diameter of this bur, no damage is done to the impression in cutting through the 36 gauge copper. The bur is started on the line (scratched on the buccal surface) as near the soft tissue as possible, and carried occlusally until the band is severed. Starting from the occlusal edge of the matrix, the copper should be folded back from the impression, and, if the matrix is still united near the gingivae, it can be torn free by pulling gently on one of the folds of the severed band. During this manipulation, finger pressure should be applied to the impression material to keep it firmly in position on the preparation.

Immediately upon the severance of the band, the authority of the restraining cylinder of copper is broken, and the elastic material is now capable of accurately recovering size and shape. Because of the gingival crimp of the band, it is rather difficult to remove the band prior to withdrawing the impression from the preparation. To preclude causing damage to the impression, it is advisable to remove the disjoined, impotent band and the impression simultaneously. A small hook instrument (made from a periodontic scaler) may be pressed into the impression material and the impression quickly snapped off the preparation in the direction of the greater subgingival undercut area (Fig. 3,*D*). Examination of the impression should show a definite crest at the gingival line, and the scratch marks left by the diamond rotators should be plainly discernible.*

It is possible to use the especially prepared type of copper band for securing an impression by first placing the impression material in the copper band, and then forcing the matrix over the preparation. However, experiments have proved that this method does not produce the detail or accuracy that the technique just described will yield (Fig. 4). Accuracy of the impression is not only important in securing a fine adaptation of the crown to the preparation, but is imperative

*Slight modifications in the impression technique recommended here will result in an excellent method of obtaining impressions for anterior porcelain veneers.

in transferring dies to a working cast. A transposition of fidelity can only be made when the die is an accurate reproduction of the preparation.

ROUGH WAX PATTERN

A rough wax pattern to be transferred to the die for detailed carving is made in the following manner: A soft copper band, a size larger than the one used for the impression, is scalloped to conform to the gingival curvature. The band is reduced in length so that when it is in position, the teeth can occlude without interference. The buccal and lingual surfaces should be expanded with the protruder to conform to the general shape of the crown of the tooth. The band is then placed over the preparation, and the buccal and lingual sides are squeezed until they conform more or less to the desired alignment. The location of the contact areas of the adjacent tooth or teeth should be marked on the band. After the band is removed, arcs should be cut from the metal at these contact areas so the adjacent contacting surfaces are exposed when the band is in position. Warmed wax is shaped into a blunt plug, the surface of the wax plug is heated prior to its being impressed part way down on the preparation.

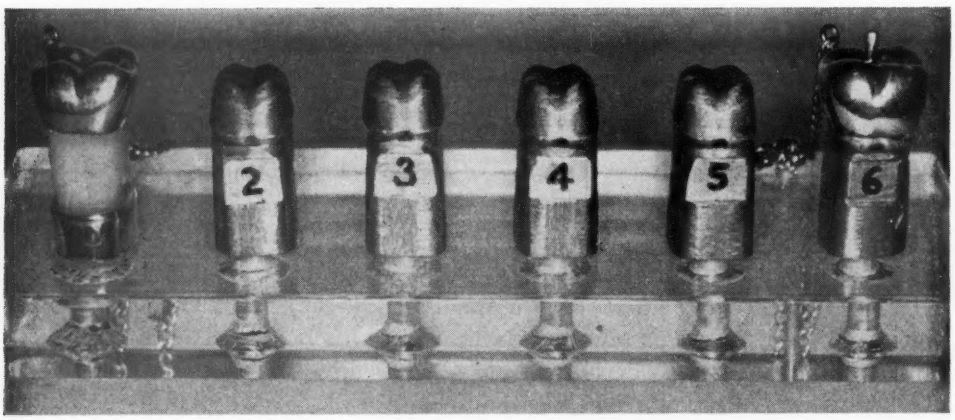


Fig. 4.—No. 1, The porcelain tooth upon which experiments were performed. Nos. 2,3,4, and 5 are copper dies upon which the two cast crowns were made (they are interchangeable). No. 6, A copper band and elastic impression material impression removed simultaneously. (It produced a rocking crown and large gingival discrepancy.)

The patient is instructed to bite into the wax until the teeth occlude. After maintaining this pressure for a short time, the wax is chilled and the surface is reheated by the use of a spatula or a stream of hot air. The sharp blade of an instrument is held against the buccal surface of the band to keep it in position, and the patient is again instructed to bite it to place. After the lateral movements are recorded in the wax, the band is removed. If the alignment of the tooth is unusual, the copper matrix should be removed, and the rough pattern heated under warm tap water to eliminate brittleness. The warmed, rough wax pattern should then be replaced on the preparation. Excess wax on the buccal surface may be contoured by reducing or adding wax as required. This rough wax pattern should now possess definite shiny marks made by contact with the adjacent teeth, in addition to a true recording of the occlusal surface in centric oc-

clusion, as well as in the ranges of the lateral excursions. It will be noted that, whereas the buccal contour has been established, no effort has been made to establish the lingual contour. The establishment of this lingual contour is not considered necessary since it will be determined by the buccal contour. It is better if the wax at the contact points does not extend too far gingivally. The observance of this precaution will minimize the possibility of distortion during removal. This wax pattern is set aside until the copper-formed die is completed, after which the details of tooth form and marginal fit are carved. If the occlusal surface and the contact points are not altered by adding more wax, the finished casting should require only a minimum of adjustment prior to polishing.

ELECTROFORMING THE IMPRESSION

Many methods and materials are used to make reproductions of preparations from the negative impression. Of all these, the copper-formed die is the most accurate and possesses many other desirable qualities. If the proper metallizer is used and if the copper sulfate bath is of the correct specific gravity, the results are constant and superior.

The copper die is soft enough to make possible easy reshaping, but hard enough to be durable. This durability makes it possible for the operator to fit and polish the casting on the die. In addition, if the die is kept at a warm temperature, the trimming and burnishing of the wax pattern presents no untoward problems of wax adaptation.

The paddle used in this technique is made from stainless steel instead of the more commonly used brass (Fig. 5). It is insulated with self-curing acrylic resin, may be made by the operator, and will last indefinitely. Any copper which is deposited on the stainless steel can be removed readily. This is a definite advantage over paddles made of brass, inasmuch as the copper deposits on brass are almost impossible to remove.

Inasmuch as the copper band has been removed from the impression, electrical contact must be established in the following way: The unsupported impression is placed in contact with the metallic upright of the paddle (Fig. 5) and is held in place with a small ball of counter wax which is pressed against the impression and the platform of the paddle. It is important to leave no crevice between the metallic upright and the impression because progression of the copper deposition will be delayed by this gap. A small quantity of molten wax should be used to fill this crevice before the metallizer is applied.

The metallizer is composed of three ingredients: Hanau's colloidal graphite, Hanau's silver powder, and a 2 per cent solution of aerosol.

Concentrated aerosol, which may be procured from chemical distributors, has the appearance of colorless gel. It is a low surface-tension product which seems to have an unlimited shelf life. However, the apparent deterioration of the 2 per cent solution makes it necessary to prepare a new mixture approximately once a month. The preparation of the 2 per cent aerosol solution is as follows: a quantity of concentrated aerosol about the size of a large pea is placed in a small shallow vessel and a small quantity of water is added. The aerosol is pressed

and manipulated with the pad of the index finger until it dissolves. The remainder of an ounce of water is then added. The result should be a pale milk-like solution.

The proportion of silver powder to the colloidal graphite is not extremely critical, but should range from equal quantities by volume of these two ingredients, to slightly more of the silver powder. Small quantities of these two ingredients are mixed with the 2 per cent aerosol solution on a glass slab with a

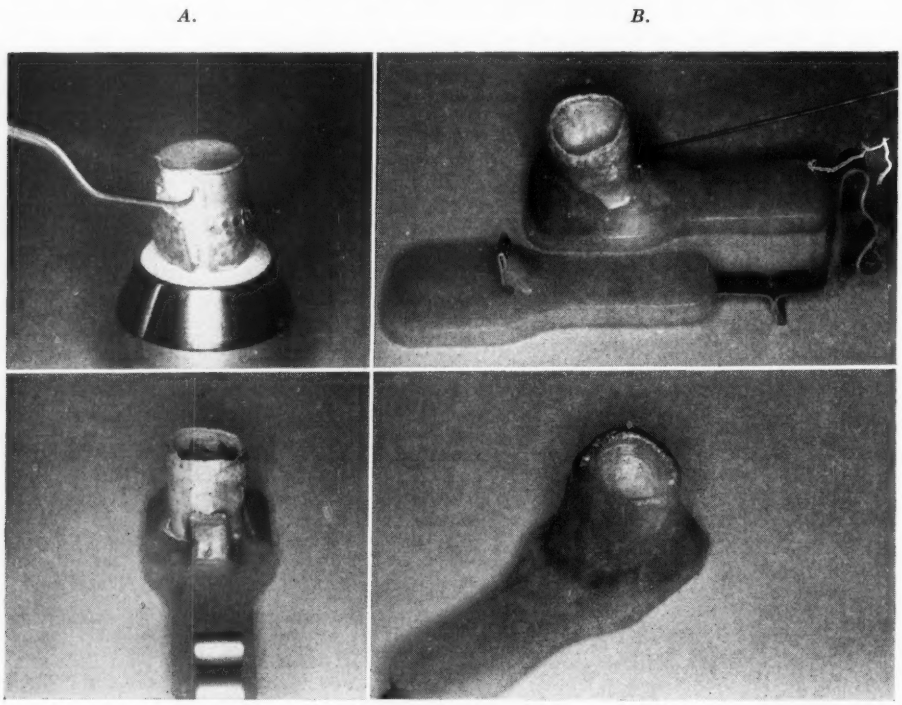


Fig. 5.—*A*, The method of removal of the copper band after it has been disjoined. *B*, The impression on the paddle held in position by counter wax. The arrow points to a gap between the metal upright and the impression which must be filled with wax before metallizing. *C*, After metallizer was used and placed in the acid bath for fifteen minutes. Copper has been deposited from the metallic upright over the ribbon into the impression. *D*, After overnight electroforming (the external surfaces were covered with wax to halt extraneous deposition of copper).

small brush. This metallizer is carried into the impression, where the surfaces are thoroughly saturated by pumping the solution into the recesses of the impression. A thin ribbon of the metallizer is painted from the rim of the impression to the metallic upright of the paddle (the cathode). The excess material is dispersed by a stream of air, which should be directed down one wall, proceeding across the occlusal surface and up the other wall, sweeping the excess ahead of the spray of air out of the impression. The ribbon extension of the metallizer is also dehydrated, and the paddle is placed in the copper sulfate bath and is subjected to 30 ma. or less for each impression. Deposition starts at the metallic cathode of the paddle and progresses into the inner walls of the impression proper.

The ingredients of the acid bath for dental impressions are copper sulfate, sulfuric acid, and water. For the most effective deposition for copper on dental impressions, the formulation should produce a solution with a Baume scale registration of 22° to 23° (1.18 to 1.20 specific gravity) at a given temperature of 25° C. (77 F.). The formula is as follows:

Copper sulfate. ($CU\text{-}SO_4$. $5\ H_2O$) — 32 oz./gal.

Sulfuric acid. (Concentrated $H_2\ SO_4$) — 14 oz./gal.

In the technique of electroforming, the variance in concentration of the acid bath is most likely to cause untoward results. Therefore, it should receive periodic attention. The hydrometer is an indispensable instrument for maintaining a constant, efficient technique, and it also makes possible the use of the solution for an indefinite period of time. When the hydrometer shows that the concentration is too high because of evaporation, distilled water should be added. The volume of the solution is also depleted by removing a small amount of the solution each time the impression and paddle are taken from the bath. Periodically, an addition of the original solution must be made to compensate for the depletion.

When a new copper anode is started, its surface should be thoroughly cleaned of any grease or foreign material. An effective method of cleaning the anode is sandblasting, which leaves the surface unsoiled and devoid of extraneous matter.

When the bottom of the copper sulfate receptacle has an accumulation of foreign particles, the solution should be filtered and returned to a clear condition. Certain additives which have been suggested as contributing improved qualities to the copper deposit have been tried but seem to be of little value.

Upon removal from the preparation, each impression should be metallized and placed in the acid bath, and immediately subjected to the electroforming. Before leaving the office in the evening, the copper ribbon and any extraneous portions of deposition are insulated against further electroforming by the application of a thin film of counter wax. This step minimizes the bulk that would otherwise be deposited during the electroforming. As a result, much unnecessary grinding is eliminated.

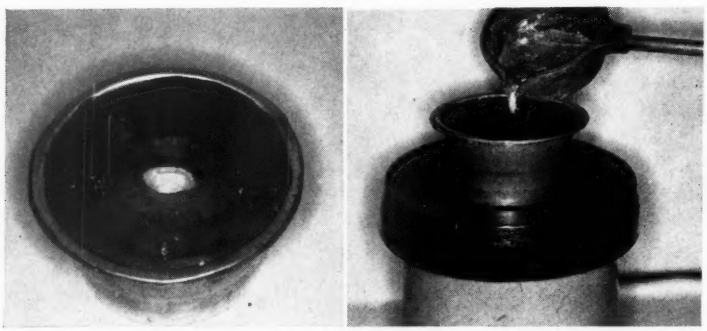
After the impressions have been electroformed overnight, they are taken from the acid bath and all insulating counter wax is removed. Small cups (like muffin tins) are filled with Raywald swaging compound and a well about ¾ inch deep is formed and the thoroughly dried impression forced against the bottom (Fig. 6). The sides of the well are molded by pressure from above, and reformed with a suitable instrument (Dixon No. 7) until they are in contact with, and extend straight up from the internal wall of the impression. Molten, low-fusing metal is poured to completely fill the well. This will furnish an extension of about ½ inch. This low-fusing metal acts to support the copper shell, while the extension acts as a handle for convenience of manipulation.

After the metal has solidified, the die is lifted from the swaging compound. The impression material is quite easily removed from the copper if it is allowed to cool beyond the soft stage. Particles still adhering to the die may be removed quickly with lacquer thinner. The excess of copper adjacent to the gingival

margin is removed with a heatless stone. Since it is extremely difficult to stone the low-fusing metal and copper simultaneously, it is important to control the flow of the low-fusing metal.

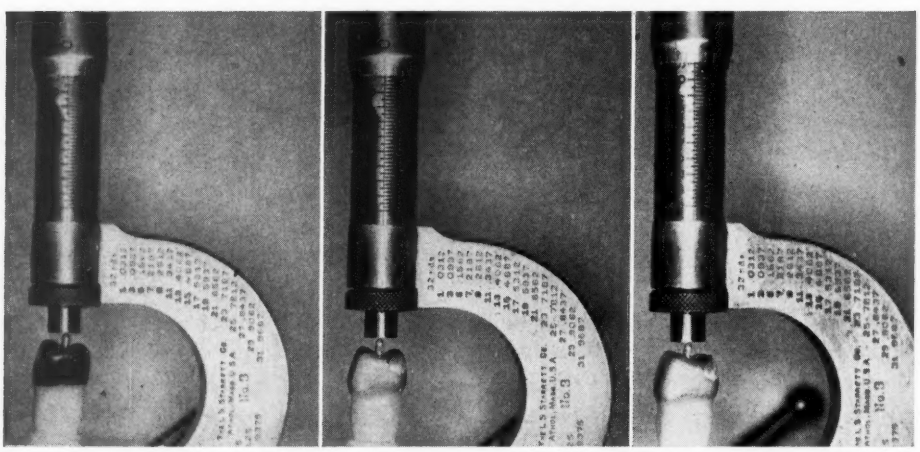
THE WAX PATTERN

The rough wax pattern which has been set aside may have slight distortions produced during its removal from the preparation. Because of the brittleness of the wax and the possibility of these slight distortions, it is important to soften the pattern under warm tap water prior to forcing it on the die. This softening of the wax will prevent the fracture of the pattern.



A. *B.*

Fig. 6.—*A*, A copper-plated impression set in Raywald's swaging compound, ready for pouring molten metal. *B*, The pouring of the low fusing metal.



A. *B.* *C.*

Fig. 7.—*A*, A waxed-up crown with a measuring post. The micrometer set at zero. *B*, The gold casting set back on the preparation shows a reading identical with *A*. *C*, After the internal surface of the crown has been subjected to 15 minutes aqua regia. It now shows the reading —0.002. This provides a like amount of metal at the gingival margin for finishing and polishing.

The die is now lubricated, melted wax is added to complete the contour, and the gingival margin is accurately formed. At this point, the wax must extend to the crest of the margin and not over it. If it does, the chilled wax which extends into the constricted area will break off when the pattern is removed from the die.

A thickened gingival margin of gold which has been advocated appears to me to be undesirable. Any recession creates a crevice between the thick gold margin and the receding soft tissue. The tooth structure which is at the base of this crevice is extremely susceptible to caries because of its location in a stagnant area. In addition, this thickened margin of gold tends to form a bulky, oversize restoration.

When the wax pattern extends to, and not beyond, the true margin, we are confronted with the problem of supplying sufficient metal for properly finishing the delicate margin of the casting. Even if the gold margin is cast to a perfect reproduction of the wax pattern, any finishing will result in a scant margin.

Since the described impression technique and electroformed die produce extremely accurate results, a method had to be evolved which would provide a sufficient surplus of metal at the gingival margin for conservative polishing. Experiments were performed using aqua regia, a solution of one part of concentrated nitric acid to three parts of concentrated hydrochloric acid, which for many years has been used in dentistry to etch and dissolve gold.

The first part of the experiment consisted of preparing an accurate wax pattern upon a complete (porcelain) crown preparation. A measuring post of 16 gauge gold wire about 3/16 inch long was melted into the center of the occlusal surface. The micrometer reading of the over-all length of the porcelain preparation, from its base to the rounded tip of the measuring post, was precisely the same when the wax pattern was in position as when the resulting casting was seated.

To prevent a scant margin after finishing, aqua regia was utilized to dissolve the interior of the casting. S.S. White black casting wax No. 7, was used to protect the external surface and 0.5 mm. of the gingival edge of the internal surface of the casting. The outer surface is easily and quickly covered by heating a stick of wax and applying it directly to the occlusal surface and on the axial walls to the gingival margin. The inner 0.5 mm. and the gingival edge are covered by using a small wax spatula. Care must be exercised to prevent the acid from seeping under the wax. The crown thus prepared is placed in aqua regia for fifteen minutes, after which the bulk of the wax is scraped off with a carver. The casting is then placed in lacquer thinner to dissolve the remaining film.

The aim of this treatment is to provide a relief within the casting to allow it to assume a new depressed position when seated on the die, thereby providing an excess of metal at the gingival margin. It was found that the micrometer reading was —0.002 inch, which is approximately the amount of excess metal now extending beyond the true gingival margin. If this gold margin is first burnished to the die, touched very lightly with a slow revolving stone, and polished, the 0.002 inch extension of metal is sufficient to result in an adequate covering of the preparation.

TEMPORARY CROWN

The cylindrical aluminum shell, as such, is not of correct form to serve satisfactorily as a temporary crown (Fig. 8). However, it can be easily and quickly reshaped to serve in a very comfortable manner.

An aluminum shell, two sizes larger than the close-fitting copper band used as an impression matrix, is cut to the approximate desired length, and festooned to conform to the gingival curvature. A No. 115 S.S. White contouring plier is inserted and the buccal and lingual surfaces of the shell are compressed and reshaped to conform to the corresponding surfaces of the tooth. On the mesial and distal surfaces, the metal is grasped with a pair of cotton pliers and given a 180° twist (Fig. 8). This forms a "Z" fold in the metal. This fold is squeezed together with a pair of narrow long-nosed pliers in order to constrict and narrow the circumference at the gingival margin to create a more normal interproximal embrasure. This newly formed band should be tried on the preparation and any further gingival festooning should be done with a crown and bridge scissors. When the fit is proper, the shell should be filled with Ward's Wondrpak, pressed over the dried preparation, and the patient should bite it to place. Because of its improved contour, it makes possible the formation of contact points as well as a close gingival adaptation which produces a very comfortable temporary crown.

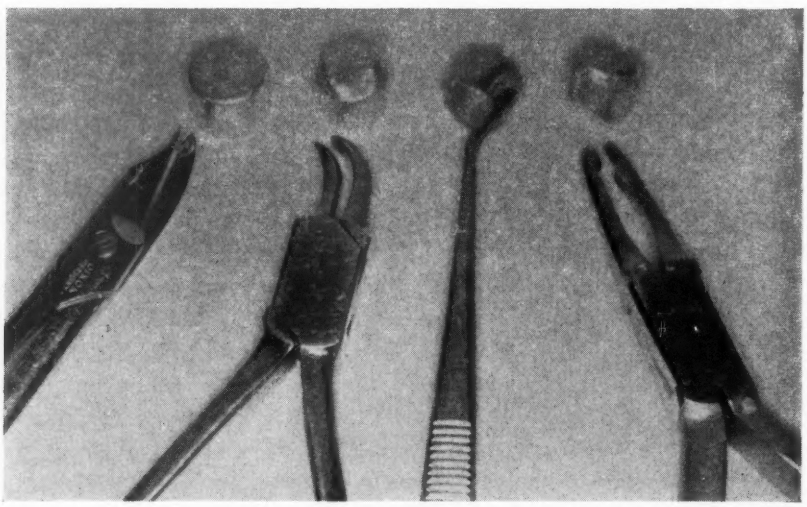


Fig. 8.—Instruments used for reshaping the aluminum cap. *A*, Crown and bridge scissors. *B*, Contouring plier No. 115. *C*, Tweezers starting a "Z" fold on the mesial surface. *D*, Contouring plier No. 114 used to refashion the gingival margin.

FITTING AND POLISHING

Before the casting is tried on the tooth, the preparation should be inspected minutely to ascertain that nothing foreign (such as particles of temporary filling material) remains which would interfere with the accurate seating of the crown.

The first step in fitting the casting on the tooth is to regulate the proximal contact points. This is followed by the use of articulating paper to locate occlusal points which require reduction. When these reductions have been accomplished, the casting is removed and seated on the die by the use of a gold foil automatic condenser with a blunt point. The occlusal tooth form should be shaped and carved with suitable fissure burs and smoothed by the use of various sizes and shapes of finishing burs.

A Robinson soft bristle wheel brush and two sets of abrasives are used for the final polish. The first set of abrasives, which is the coarser, consists of tripoli, and a thick mix of water-moistened silex. For subsequent usage the mixtures of silex and water and white rouge and water should be kept in small rubber bowls which can be squeezed to pulverize the dehydrated powder. The Robinson soft bristle brush No. 11 should be rotated on the cake of tripoli, after which the silex solution is applied to the casting with a finger tip. The tripoli-coated brush is run at the highest speed with firm pressure exerted against the surface of the casting. A high luster is best produced by exerting heavy pressure when the polishing process begins. This pressure should be gradually lessened until only the tips of the bristles are lightly skimming over the surface of the casting. This procedure is repeated until the deepest scratches are obliterated.

The set of finer abrasives consists of gold rouge, and a mixture of white rouge or tin oxide and water. The white rouge, which is used for the final polish by lens grinders is available at optical supply houses. This second set of abrasives is used in the same manner as the first.

The reason for the utilization of these mixtures in conjunction with the tripoli and gold rouge is to prevent the caking of the tallowlike substance in the deep crevices. Such a deposit in these crevices and indentations prevents the bristles from reaching the surface of the gold casting.

After the final polishing, the interior of the casting should be wiped with a cotton pellet dipped in chloroform to remove any remaining rouge. It should then be brushed gently with a solution of household detergent and water, and thoroughly dried before cementation.

EXPERIMENTS IN CEMENTATION

Over a period of time, clinicians and operators have experimented and proved that no dental cement will allow complete seating of the casting upon the preparation. This faulty seating results in a disturbed occlusion which needs immediate adjustment for comfort. It also results in the ruination of an otherwise fine margin. Since only a smooth, even continuous margin between the subgingival tooth structure and the polished gold of the crown is accepted by the gingival tissue without pathologic reaction, and because the life of any cemented resortation is to a great extent determined by the closeness of the metal margin to the preparation, cementation is a very important consideration.

For many years it has been advocated that a vent be drilled through the occlusal surface of the crown in order to allow maximum seating. The importance of this vent is in direct ratio to the accuracy and adaptation of the casting to the preparation. An ill-fitting crown provides ample means for the cement to find egress from confinement. In a crown of close adaptation, the avenue of escape decreases progressively. It is in the final seating that the cement escape channel assumes its greatest value by relieving compression from within.

In order to substantiate this hypothesis the following experiments were conducted. A lower molar complete crown preparation was formed from a block of porcelain, and a wax pattern with an occlusal measuring extension was cast and

fitted. The apical portion of the porcelain tooth was made with a keyed platform to fit precisely into a low-fusing metal receptacle attached to the lower arm of the micrometer. With the crown on the porcelain preparation in central position between the micrometer jaws, the extension was lowered until the micrometer registered on zero.

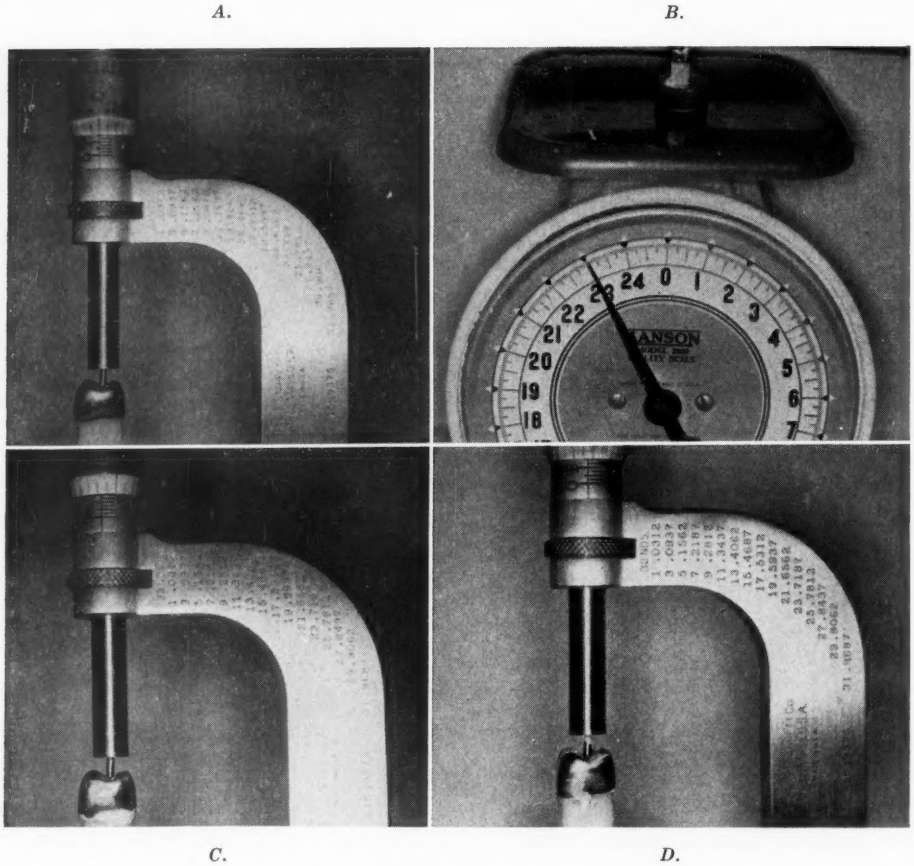


Fig. 9.—*A*, The cast crown on the porcelain preparation. *B*, The crown cemented and pressed to place, using 23 pounds pressure for 10 minutes. *C*, After the cement had set, it showed a reading of almost +0.002. *D*, In this experiment, a vent is made in the mesiobuccal cusp with a No. 59 twist drill. Cement, pressure, and time is identical with *C*. The resulting measurement is +0.0005. The advantage gained by the vent is therefore nearly 0.0015.

One-half pennyweight of (Fleck's) cement was incorporated in ten drops of liquid. This mixing extended over a two-minute period, after which the cement was placed in the crown, forced over the preparation, and subjected to 23 pounds of pressure for a period of ten minutes. The micrometer reading registered an elevation of nearly 0.002 inch, which signifies that the gingival margin is scant by this amount.

After the cement was dissolved to separate the casting from the porcelain preparation, a cement escape channel was drilled through the mesiobuccal cusp with a No. 59 twist drill (18 gauge clasp wire fits snugly into this size vent).

Under identical conditions, this crown was recemented to the porcelain preparation. This time the micrometer showed an elevation of 0.0005 inch; the approximate minimum discrepancy that can be achieved. Therefore, the value of the cement escape channel is equal to the difference between 0.002 and 0.0005 inch, or 0.0015 inch.

The cement escape channel may also influence the period of sustained pressure required to allow the cement to flow from beneath the crown. Despite the fact that we have been admonished to continue pressing the casting to place for a long period of time, an experiment identical to the foregoing was performed, but the 23 pounds of pressure was applied for one-half minute instead of ten minutes. Both produced the exact elevation of 0.0005 inch, which seems to indicate that sustained pressure on a full crown during cementation for any time over one-half minute is unnecessary.

Although occasionally a cast crown may be produced requiring no occlusal or contact adjustment, usually some minor regulation is required in order to conform to the existing occlusion. Even after the restoration is declared in normal occlusion, it is advisable to mark the occlusion again with articulating paper. Any spot should be reduced slightly before polishing. A crown that is left in supraocclusion results in a tooth that is sensitive to mastication and hypersensitive to thermal changes. It may result in the destruction of the alveolar process not only of the surrounding crowned tooth but of the opposing teeth as well.

CEMENTATION

Immediately upon removal of the temporary crown, the preparation and the gingival crevice should be examined carefully, and any temporary cement removed. A stream of warm air directed between the gingiva and the tooth surface will reveal any fragment lodged in the crevice. The dislodging of temporary cement from this crevice will usually cause minute hemorrhages from the irritated gingivae. If the gingivae are left undisturbed from this time until the crown is adjusted and polished, these hemorrhages will have subsided and no special medication will be necessary. Loose particles in the oral cavity should be drawn out with the Vacudent.

It is sometimes necessary to force the gingivae away from the preparation surface lest the soft tissue be captured and impinged by the gingival edge of the crown when it is being cemented. Cotton points (as used in endodontics) cut into various lengths and dipped into a suitable medication can be inserted in the dried crevice. Upon removal of the cotton points, the gingivae will remain displaced for a time sufficient to allow the crown edge to pass through.

When the crown is ready for cementation, the mixing of the cement is started. It should take about two minutes for the assistant to incorporate the powder into the liquid. After the cement has been mixed for about one minute, the cotton rolls are inserted and held in position by some suitable means. The assistant fills the crown with cement. Simultaneously, the operator dries the preparation and the gingival crevice and immediately places the cement-filled crown over the

preparation. It is pressed to place with the 18 gauge gold wire in the vent. If the vent is not corked, a quantity of cement escapes and prevents its flow ahead of the crown into the important gingival area. After the crown is seated by finger pressure, the clasp wire stopper is removed, and a bite post is placed between the restoration and the opposing teeth. The patient must bite with sustained force for at least thirty seconds, after which he can relax. The clasp wire plug is replaced in the vent and seated to its full depth through the still soft cement. Prior to cementation, this wire plug should be almost severed at a predetermined point. This will (1) allow the bending of the wire to an angle for ease of placement, (2) allow the use of an excess length of wire as a handle which will facilitate its placement, (3) serve as a fracture point after insertion. When the plug is in place, the excess wire is bent back and forth until it fractures. The inserted wire should extend beyond the crown surface approximately 0.5 mm. to allow for stoning and polishing after the cement is set. The initial setting time should be about seven minutes, after which the excess cement is carefully removed.

The gingival tissue will heal quickly from any mutilation incidental to the production of a complete crown, provided the subgingival margins are accurate and the gold surface is polished. The toleration of the gingival tissue to this metal is comparable with the original enamel, for it lies in complete tranquility and adaptation to this enamel substitute.

The complete cast crown can be the most valuable and durable restoration produced. In order to achieve maximum accuracy, the techniques employed must be logical, for only then can the result be commensurate with the operator's skill and ability.

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CEMENTATION OF FIXED RESTORATIONS

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CEMENTATION IS THE FINAL step in fixed restorative dentistry. It may be a contributing factor either to the success or failure of the best fitting crown or bridge. It is a common and heartbreaking experience to find an increased occlusal vertical dimension after cementation where, before cementation, the restoration occluded perfectly well.

In the days of the swaged shell crown or the so-called two piece crown, the adaptations of the margins of the crown to the margins of the prepared abutment were far from adequate. This allowed plenty of space for the escape of the excess cement, thus giving little resistance to the ultimate seating of the restoration. This is not the case with the modern cast crown or the plastic veneered cast gold crown.[1] Precision casting produces perfectly and snugly adapted crowns, with the entire interior surface as well as the margins in intimate contact with the preparation.

Though a tight fit of a crown is desirable, it may be and very often is the source of trouble and failure. This tight fit coupled with the resistance to flow caused by the viscosity of the cement prevent the full escape of the cement. A certain thickness of the cement remains interposed between the prepared tooth and the crown. This difficulty of the proper seating of the restoration is greatly increased when large bridges involving a quadrant or a full arch with many abutments are to be cemented.

An inadequately cemented restoration may cause: (1) an increased vertical dimension of occlusion, (2) a loosening of the crown or bridge after a relatively short time, (3) leakage and decay under the abutments, (4) the unsightly appearance of a gold margin where originally the gold was concealed under the gingivae, and (5) sensitivity to sweets, brushing, etc., due to the exposure of the cervical end of the tooth.

Many methods have been suggested to relieve that inner strain or resistance caused by the trapped cement. It has been suggested that a hole be drilled in all crowns before cementation. The holes are filled later with cohesive gold foil.

Shooshan[2] recommends the making of an escape hole near the mesiobuccoocclusal aspect of a crown, and then closing the escape hole, after cementation, with a pure gold 18-gauge wire which is then riveted and smoothed.

A simpler technique takes advantage of acrylic resin facing on the acrylic-faced cast gold crown,[1] or acrylic resin veneer crown.

Received for publication Feb. 13, 1956, revised Aug. 16, 1956.

CEMENTATION TECHNIQUE

With a large round bur, relieve the occlusal or incisal two-thirds of the inside or the interior of the crown (Fig. 1), being careful not to cut into any thin areas and the relatively thin wall which backs the acrylic resin facing.

Using a No. 1 round bur for the anterior tooth, and a No. 2 round bur for the large bicuspids and molars, drill a hole through the plastic and gold backing,

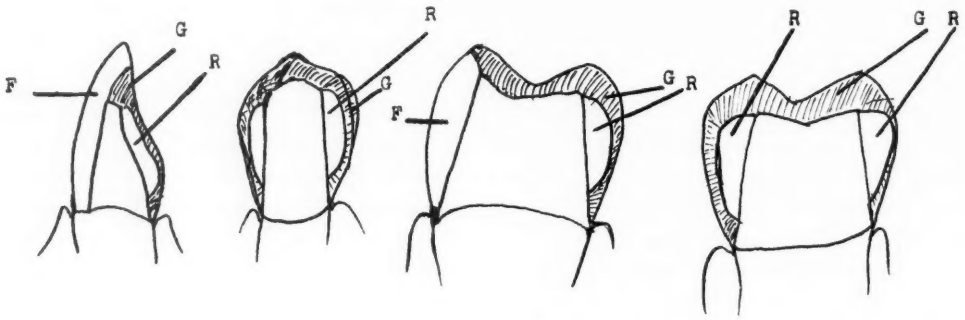

Fig. 1.—(Longitudinal sections.) Side and front views of relieved areas in plastic or acrylic-faced cast gold crowns. *F*, facing; *G*, gold; *R*, relieved areas.

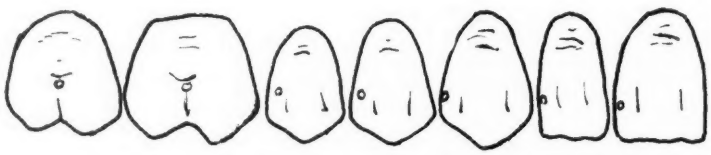

Fig. 2.—Placement of "escape" holes in different crowns.

reaching the inside of the crown. This hole will act as an "escape" through which the excess cement will ooze freely. On incisors and canines, the escape hole should be located on the distolabial-incisal third as close to the contact area as possible, in order not to affect the appearance of the crown. On bicuspids, the escape hole should be drilled at the distobuccal line angle. On molars, it should be located on the buccal surface at the junction of the middle and the occlusal third of the restoration (Fig. 2). If a plastic pontic is adjacent to a full crown abutment, a hole can be drilled diagonally from the plastic facing of the pontic through the contact point into the abutment.

On cementation, pressure should be applied on the restoration as long as cement continues to ooze out. When no more cement appears, check the occlusion because the resistance to the complete seating of the crown or bridge may be caused by improper placement or wedging.

CLOSURE OF ESCAPE HOLES

After cementation, a round bur slightly larger than the escape hole is used to drill out the freshly set cement to a depth of about 3 mm., or less if the plastic facing is thinner. Make sure not to drill into the tooth.

The escape holes are then cleaned of debris and dried. A quadrant of the mouth is thus prepared and kept dry with cotton rolls. A self-curing resin filling material of the right shade is mixed to a fairly thin consistency and placed in a jiffy tube, or applicator tube with a very fine nozzle. The resin is injected into the escape holes from these tubes. Immediately before the resin has set, some dry resin powder is added to the resin in the escape holes to absorb the excess monomer and speed up the setting. This will produce a hard resin plug in the hole. After the resin is set, it is polished.

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THE HOLLOW BULB OBTURATOR FOR ACQUIRED PALATAL OPENINGS

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Kansas City, Mo., and Memphis, Tenn.

ACQUIRED OPENINGS of the hard or soft palates interfere with the speech pattern and the mechanism of deglutition, and, of equal importance, produce a feeling of social insecurity with unfavorable psychologic as well as economic consequences. Patients with palatal defects labor under handicaps that cannot be fully appreciated by those with normal palates.

The dentist should use his specialized training and prosthetic abilities to treat those persons who need the precise type of prosthesis required to correct acquired openings of the hard and soft palate.

Acquired openings of the hard and soft palate may be a result of trauma, disease, pathologic changes, radiation burns, or surgical intervention. The opening produced may be quite small or it may include any portion of the hard and soft palate, the alveolar ridges, and the floor of the nasal cavity.

There are two important reasons for correcting the acquired palatal defect as soon as possible. First, the physical development and well-being of the patient will be protected, and, second, the morale and mental development of the patient will be greatly improved.

THE INDICATIONS FOR THE USE OF AN OBTURATOR

An obturator may be used: (1) to act as a framework over which tissues may be shaped by the surgeon; (2) to serve as a temporary prosthesis during the period of surgical correction; (3) to restore a patient's cosmetic appearance rapidly for social contacts; (4) to provide for an inability to meet the expenses of surgery; (5) when the patient's age contraindicates surgery; (6) when the size and extent of the deformity contraindicates surgery; (7) when the local avascular condition of the tissues contraindicates surgery; and (8) when the patient is susceptible to recurrence of the original lesion which produced the deformity.

THE ADVANTAGES OF A HOLLOW BULB OBTURATOR

A hollow bulb obturator offers certain advantages: (1) The weight of the prosthesis is reduced, making it more comfortable and efficient. (2) The lightness of the prosthesis changes one of the fundamental problems of retention and increases

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Received for publication April 27, 1955, revised by the authors July 9, 1956.

physiologic function. (3) The decrease in pressure to the surrounding tissues aids in deglutition and encourages the regeneration of tissue. (4) The light weight of the hollow bulb obturator does not add to the self-consciousness of wearing a denture. (3) The lightness of the prosthesis does not cause excessive atrophy and physiologic changes in muscle balance.

TECHNIQUE FOR CONSTRUCTING A HOLLOW BULB OBTURATOR

The technique to be described is simple, and it is given in a step-by-step sequence which should challenge the dentist who has not considered rendering this type of service to do so, when it is indicated.

1. The palatal defect is sprayed with 10 per cent cocaine hydrochloride to reduce the sensitivity of the involved tissue (Fig. 1).

Fig. 1.—The appearance of a palatal defect following radical resection of right maxilla for a mixed cell tumor.

2. One-inch petroleum jelly gauze is used to pack off the nasal portion of the defect and to block out the undercut region.

3. A stock impression tray of adequate size is selected.

4. Softened modeling compound impression material is placed in the selected tray, inserted into the mouth, and pushed into place. Other impression materials, such as the hydrocolloids, could be used, but modeling compound works very well, if properly used.

5. The anterior portion of the tray is moved up and down a few times while the impression material is still soft to prevent undercuts from locking the impression into the palatal defect.

6. After the impression compound hardens sufficiently, the impression is removed and trimmed. Additional compound is added where necessary, and the impression is reinserted for molding of its borders.

7. A thin layer of a zinc oxide and eugenol impression paste is spread over the muscle-trimmed impression. The impression is inserted into the mouth and held firmly in place until the impression paste has set.

8. The completed impression is boxed, and a cast is poured in the usual manner.

9. The centric relation and vertical dimension are recorded, and the maxillary and mandibular casts are mounted on an articulator.

10. The teeth are set up and the wax pattern of the prosthesis is flasked (Fig. 2), and the wax eliminated (Fig. 3).

11. The cavity in the mold (the replica of the palatal defect) is lined with a double thickness of regular baseplate wax. A paper clip is adapted so a loop extends down into the cavity, while the ends of the wire rest on the artificial stone cast or the investing artificial stone in the flask (Fig. 4).

12. Notches are cut in the stone to accommodate the paper clip so it can be reseated accurately and thus reseat the cast stone bulb when the acrylic resin is packed. The loop of wire extending into the cavity is seated to the wax lining.

13. With the paper clip in place, a stone cast is poured into the cavity that has been lined with baseplate wax (Fig. 5). This cast is allowed to set for one hour, and then the wax is eliminated.

14. The cast in the flask including the cavity and stone cast containing the paper clip are covered with tin foil (Fig. 6). The notches in the surface of the cast and its investing stone (for the paper clip) are left bare to assure the accurate placement of the removable stone cast attached to the paper clip. The removable stone cast is not allowed to move laterally in any direction, or the wall of the hollow bulb when completed would be too thin to allow for adjustment.

15. Acrylic resin is packed in the cavity and the tin-foiled removable cast is forced into position with the paper clip seated in the prepared notches to guide and maintain its position (Fig. 7).

16. The opposite side of the flask is packed with acrylic resin in the usual manner but with two thicknesses of Cellophane between the resin in the top and bottom parts of the flask. This split pack will prevent the resin in the two parts from adhering when they are trial packed. Two thicknesses of Cellophane are also used for the final packing and curing.

17. After the resin has been processed and cooled, the flask is opened. The stone is cut out of the obturator, and the tin foil is removed from the inside of the obturator.

18. Then 1 mm. of acrylic resin is cut away from both the obturator and the denture base where the two will be joined.

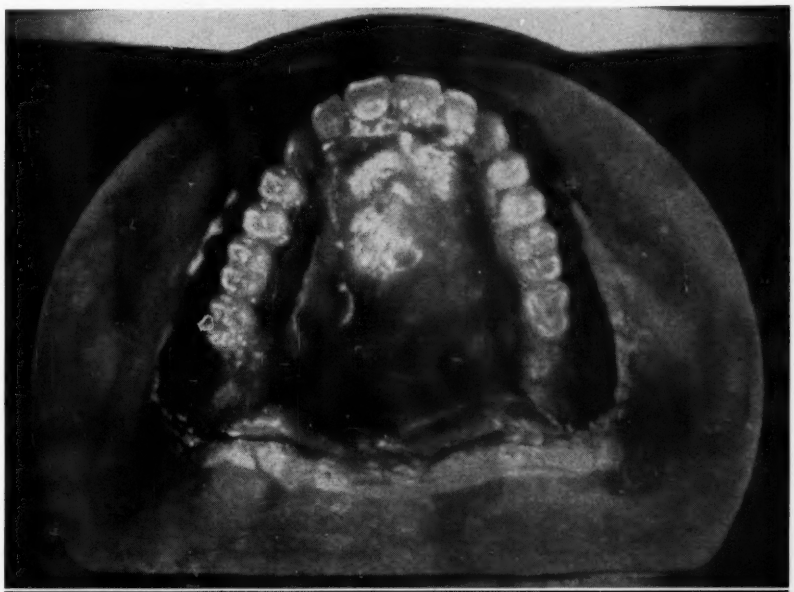
19. A small amount of self-curing acrylic resin is mixed. Then both the cut surfaces of the obturator and the denture base are bathed with monomer on a small cotton applicator. The prepared mix of acrylic resin is added, and the flask is closed and left in a bench press for a minimum of one hour for the final curing.

20. When the resin is completely cured, the restoration is removed from the flask, finished, and polished.

CASE REPORT

A 64-year-old white man, edentulous, was referred to the Prosthetic Clinic, University of Tennessee, College of Dentistry, for the construction of an oral prosthesis to correct a palatal defect.

Fig. 2.



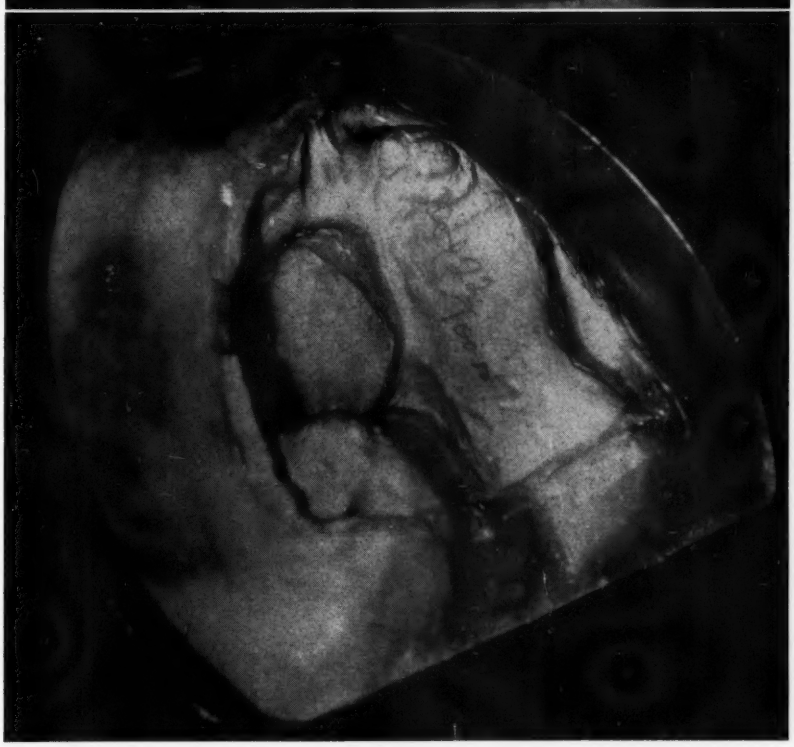
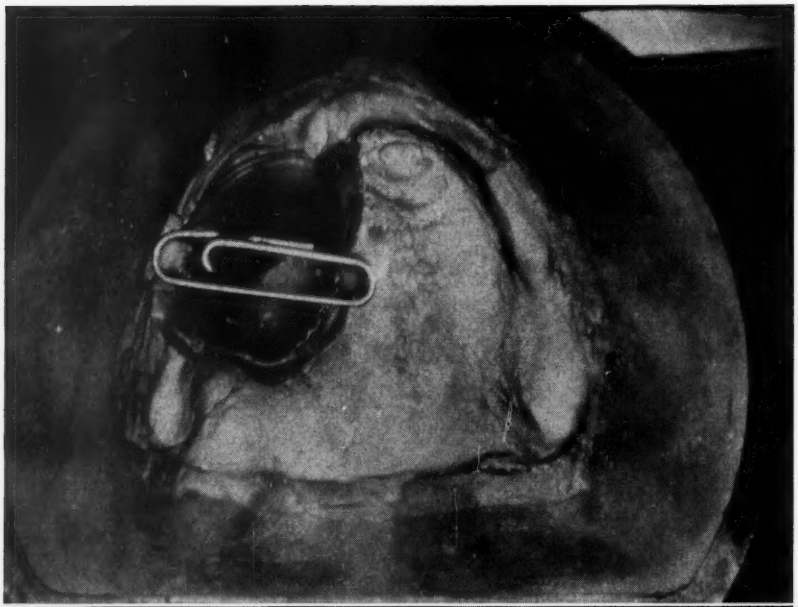


Fig. 3.

Fig. 2.—The teeth have been set up and the wax pattern of the prosthesis is flasked.
Fig. 3.—The bottom half of the flask after the wax has been eliminated.

Fig. 4.



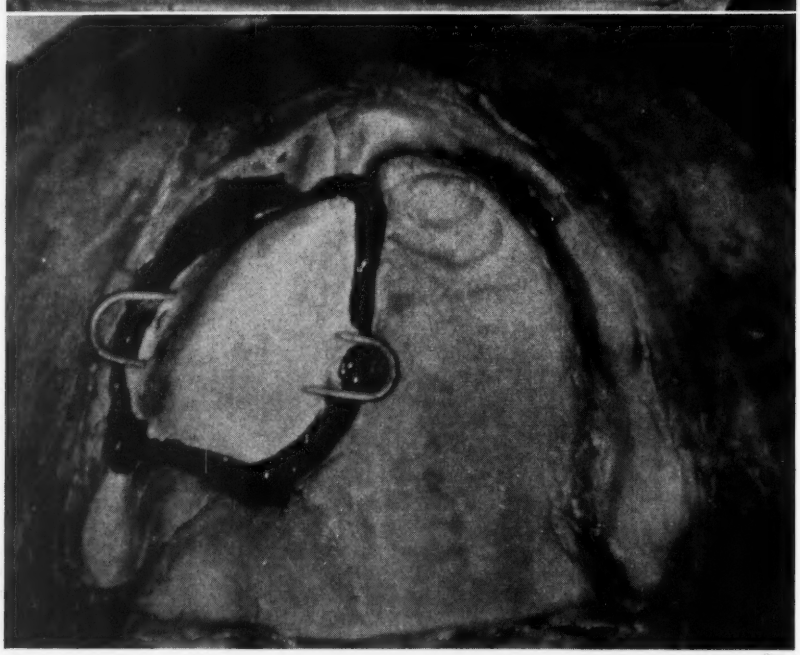
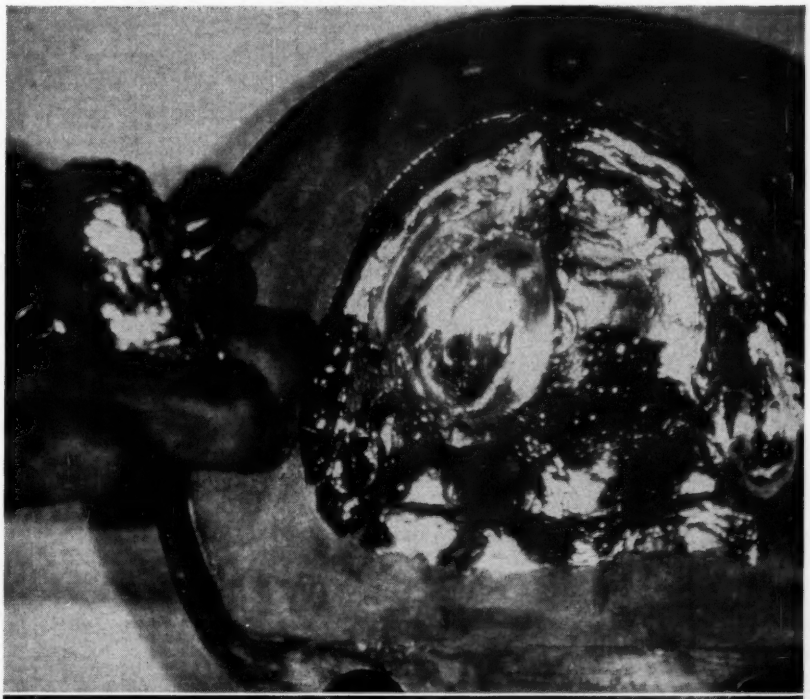


Fig. 5.

Fig. 4.—The palatal defect is lined with a double thickness of baseplate wax, and a paper clip is adapted into the defect, and supported by the cast on the margins of the defect.

Fig. 5.—A stone cast is poured into the wax lining the defect, and molded to restore the shape of the maxillary ridge.

Fig. 6.



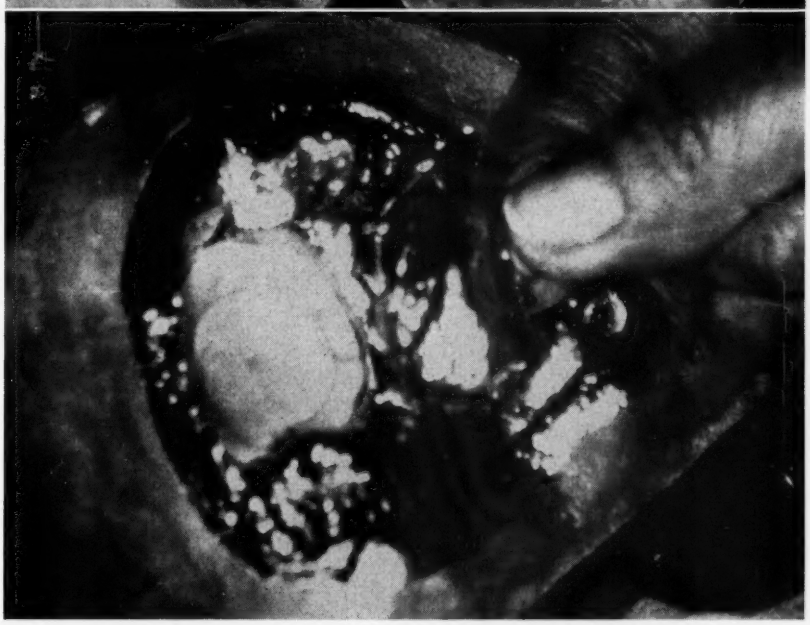


Fig. 7.

Fig. 6.—The entire cast and the removable stone cast containing the paper clip are tin-foiled before packing.

Fig. 7.—Acrylic resin is packed into the cast of the palatal defect. The top half of the flask is packed in the usual manner. Two sheets of Cellophane are used to separate the resin in the split pack.

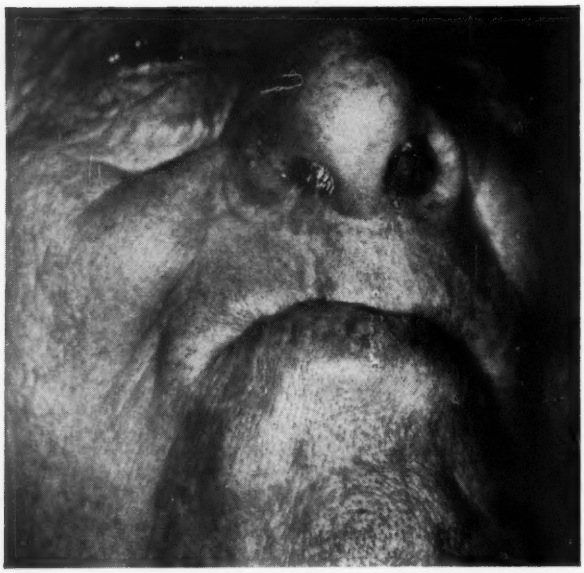


Fig. 8.—The lips are not properly supported without the restorations.

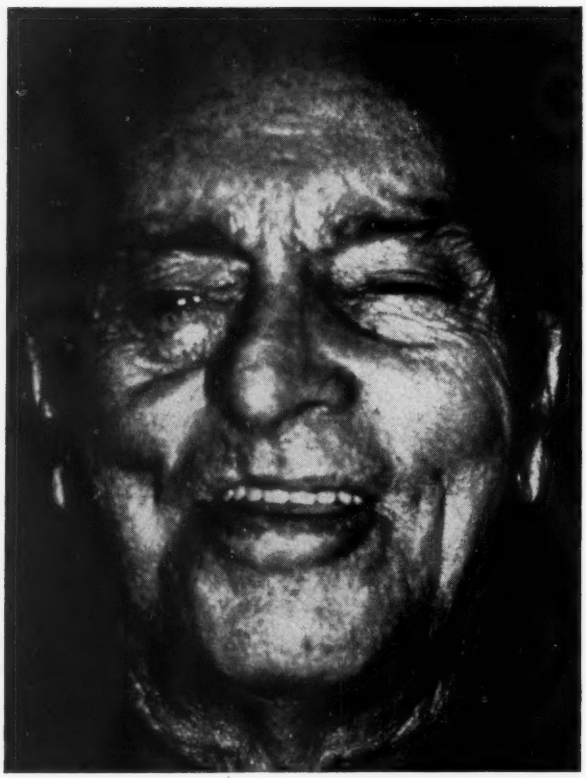


Fig. 9.—The patient's appearance and facial expression are much improved with the prosthesis in place.

The patient had undergone surgery two months previously for the removal of a mixed-cell tumor involving a portion of the hard palate (See Fig. 1). Due to the patient's age, general physical condition, and the possibility of recurrence of the tumor, further plastic surgery was not recommended.

A complete review of the patient's history was made, and a clinical oral examination was completed. The patient was not able to take either fluids or solid foods by mouth without considerable discomfort to the tissues involved about the postoperative opening. Deglutition and intelligible speech were almost impossible.

The procedure selected for the correction of the palatal defect was the construction of a hollow bulb obturator as a part of a complete denture. At that time, we considered it advantageous to discuss with the patient the advantages and disadvantages of the prosthesis in order to secure his full cooperation.

After the prosthesis was completed, it was inserted into the mouth to check for accuracy and retention, which were ideal. The patient required only two minor adjustments during the first two weeks. He was seen again in six weeks without any complaints and was very appreciative of the results. He was able to drink and eat as a person without a palatal defect, and his speech was improved from 50 to 75 per cent. The patient's appearance and facial expression were much improved (Figs. 8 and 9).

It is often necessary for patients to seek instructions from a speech therapist with experience in cases of this type. The improvement of speech varies with different persons. Some patients will adapt themselves readily. Others will not be able to overcome speech deficiencies without the aid of an instructor.

It is also necessary for the patient to take certain mouth exercises to strengthen the associated muscles and tissue tonicity to obtain maximum efficiency from a prosthesis.

In an attempt to produce a satisfactory obturator, each patient must be considered as an individual problem presenting its own peculiarities and requiring a special technique. The dentist should be constantly searching for new techniques and materials to make a more adaptable, comfortable, and natural-looking prosthesis.

We would not leave the impression that an obturator is a substitute for plastic surgical procedures for the correction of openings in the hard and soft palate. Surgical intervention should be the treatment of choice, if, after consultation, it is believed that satisfactory results can be obtained. However, plastic surgery should not be performed in every case without giving due consideration to the possibilities of an obturator.

SUMMARY

Every dentist should be challenged to assist in rehabilitating the increasing number of patients with palatal defects which are not recommended for surgical correction.

The dentist, due to his specialized training, is prepared to construct precise oral prostheses for these patients.

A simplified step-by-step technique for the construction of the hollow bulb obturator has been presented, and its advantages are given.

Acknowledgment is made to Margaret Pace, prosthetic technician, for her cooperation in the laboratory procedure.

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Book Reviews

BONE AND BONES. By Joseph P. Weinmann, M.D., and Harry Sicher, M.D. Second edition. 508 pages, illustrated. St. Louis, 1955, The C. V. Mosby Company. Price $13.75.

This excellent treatise is a "must" for the professional library of every practitioner of dentistry. It represents not only the authors' original investigations but is also in reality a source book on the subject of the anatomy, physiology, and pathology of bone. It contains 302 fine illustrations, most of which are originals; there is a well-arranged index, and there are several pages of references, which are arranged according to chapter topics, thus serving a valuable addition to the book for the benefit of anyone interested in pursuing some topic further.

Part I deals with the normal structure and growth of bone and bones. In regard to the terms bone and bones, emphasis is placed upon the fact that "Bone is a tissue. Bones are organs." This concept greatly clarifies the confusion usually existing with reference to the use of these two terms. In Chapter I is a description of the structural elements of bone tissue, the arrangement of these elements, and the development and growth of bone tissue. In Chapter II the details of the structural elements of the skeleton and their development are described, including endochondral and membranous development of bones. Also, a clear description of the functional adaptation of bones is provided.

Part II, which includes the remaining nine chapters, treats of the pathology of bone and bones. Included under this heading are such topics as developmental disturbances of bone tissue (e.g., osteogenesis imperfecta) and of bones (e.g., hereditary multiple exostoses), adaptational deformities of the skeleton (e.g., spinal curvature, flatfeet), the influence of endocrine glands and vitamins upon bone and bones, as well as tumors, infection, necrosis, and regeneration of bones. Of particular interest and importance are the numerous dental implications throughout the book, as, for example, the development of the jaws and paranasal sinuses, the biologic plasticity of bone, the process of repair of tooth sockets and of the atrophic changes in the jaws when teeth are lost, and the reaction of bone to the growth of tumors.

Since this reviewer makes no claim of any knowledge of oral pathology, no opinion is expressed here as to the validity of the material presented in the text under that category. However, it is stated here without any reservations, that every topic dealt with in this invaluable text from cover to cover not only makes interesting and informative reading, but is of inestimable value to any member of the dental profession whose practice entails a knowledge of the anatomy, physiology, and pathology of living bone and bones.

Linden F. Edwards

HYPNOSIS AND ITS THERAPEUTIC APPLICATIONS, Edited by Roy M. Dorcus, Ph.D. 313 pages, indexed, tables and figures. New York, 1956, McGraw-Hill Book Company, Inc., Blakiston Division. Price $7.50.

This book was written primarily as a teaching aid (textbook) for students and instructors of hypnosis, but it contains excellent reading material for all who are interested in this subject. The authors are specialists in their various fields and have incorporated their experiences in the chapters they have written. Each chapter is documented with an extensive and current bibliography, having a total of 354 references. Those germane to the subject have been

critically analyzed, summarized, correlated, and presented by logical reasoning. The authors' method of approach is to present these various theories, experimental results, and therapeutic applications in this one volume, thus making a valuable contribution to the literature by saving the reader the task of searching for numerous references.

The material is arranged in a sensible and orderly manner, and the length of the chapters is, in most instances, compatible with their clinical value. However, with the exception of the last chapter, there is no step-by-step procedure given for the control of the patient. An explanation of patient control during hypnosis is essential, especially to students. A slight abuse of the privilege of using nomenclature peculiar to this branch of science was noted.

Four theories of hypnosis are presented and evaluated. These are: the sleep theory, dissociation, conditioned response, and role-taking or goal-directed, no one of which is adequate, but all of which contain some measure of truth. Then the authors delve into methods of induction, dehypnotization, susceptibility of the subjects, variations in susceptibility, variability in responsiveness to suggestions in the trance, and criteria of hypnosis (is it real or simulated?).

Other phases such as control of sensory and perceptual functions (sight, hearing, taste, touch, pain, warmth, vertigo, fatigue, and sense of time) are discussed.

The physiologic effects of hypnotic stimulation produce variable reactions, e.g., one subject may respond somnambulistically (deeply), and another may not respond at all to identical induction stimuli; or the same subject may respond differently to the same induction presented on different occasions.

The effects of hypnosis on the respiratory system, gastrointestinal tract, genitourinary tract, secretions, central nervous system (analgesia), frigidity, impotence, dysmenorrhea, functional amenorrhea, painless childbirth, heart rate, vasomotor changes, and metabolism are noted.

The last six chapters are devoted mainly to uses and clinical applications of hypnotic therapy, i.e., as a diagnostic tool to be used to supplement or replace other methods that have failed; as a symptom control by direct suggestion, and in supportive therapy.

The final chapter is devoted mainly to problems encountered in a dental practice. This is relatively a new application, but it is and will become more important in the future, and every dentist should have knowledge of it. Pain, which is the guardian angel of our health, is discussed in all its various aspects. Hypnosis can be used to combat the syndromes most commonly productive of psychosomatic manifestations, such as fear, anxiety, tension, hostility, dread, worry, apprehension, and all other emotional conflicts. It can be used to eliminate other bad habits such as thumb-sucking, nail-biting, gagging, bruxism, etc.

The prosthodontist will find hypnosis very useful as an aid in registering central relation and vertical dimension, as well as in conditioning patients to the proper attitude for wearing dentures.

The use of words during hypnosis should be within the meaning range of the patient and should be euphonic (soft) instead of harsh sounding. As the author points out, hypnosis should not be considered a panacea for curing every affliction, but should be looked upon as another method of therapy to be employed when it is warranted.

W. Russell Kampfer

A TEXTBOOK OF OPERATIVE DENTISTRY. By William H. O. McGehee, D.D.S., M.D., Harry A. True, D.D.S., and E. Frank Inskipp, B.S., D.D.S., Edition 4, 720 pages, with tables and illustrations, indexed. New York, 1956, McGraw-Hill Book Company, Inc. (Blakiston Division). Price $14.00.

The fourth edition of this well-known textbook (it was published first in 1930) shows several noteworthy changes over the previous editions. There is still the tendency, common to similar texts, to include material that can be considered extraneous and repetitious of other fields.

A group of contributors have been utilized in bringing the general material up-to-date. A chapter, "Accuracy With Speed," has been added that introduces the adoption of high-speed rotary instruments, the principles of washed-field operating, and the use of airbrasive. Indirect methods for constructing gold inlays are described more fully in this edition, particularly the reversible hydrocolloid technique. Although several other indirect methods are presented, there is no mention of the use of the newer rubber-base materials and the alginates. An extensive chapter, "Operative Dentistry for Children," appears for the first time in this edition.

The other chapters, to a great extent, follow the plan and content of previous editions and reflect the traditional treatment of material contained in operative dentistry "textbooks": diagnosis, diagnostic methods, instrumentation, the dental office, the dental assistant, rubber dam, dental caries, cavity preparation, restoration of tooth structure, restorative materials, and diseases of the pulp.

To this reviewer the appearance of this text, in the year 1956, emphasizes still again that a new approach in the planning and in the scope (or the limitations) of the contents of an "operative dentistry" textbook, would be welcomed by the profession. There is a need for a critical and realistic appraisal of just what such a text should contain and how these contents should be presented. A more widespread recognition of the current, modern, and rapidly changing methods in both dental practice and dental teaching should be given serious consideration by authors and their publishers.

T. F. McBride

COMPLETE MOUTH REHABILITATION THROUGH CROWN AND BRIDGE PROSTHODONTICS. By Harry Kazis, D.M.D., and Albert J. Kazis, D.M.D. 392 pages with 551 illustrations on 332 engravings, indexed. Philadelpha, 1956, Lea & Febiger. Price $15.00.

In the new "Glossary of Prosthodontic Terms," prepared by the Academy of Denture Prosthetics and published in the JOURNAL OF PROSTHETIC DENTISTRY, March, 1956, *mouth rehabilitation* is defined as "restoration of the form and function of the masticatory apparatus to as nearly a normal occlusion as possible." In this text, Kazis and Kazis present their techniques and procedures to accomplish that end. They preface their methods of reaching this goal by stating, "The aim and endeaver . . . is reconstruction and rehabilitation of the whole, satisfying all the related factors, including the health of the periodontium, vertical dimension and freeway space, balanced functional occlusion and the esthetic requirements."

The first section of the book considers at length the theories and basic principles fundamental to mouth rehabilitation. This is followed by the presentation of twenty-five practical case reports, typical of those occlusal anomalies that may be encountered in practice, illustrating the methods and techniques employed in correction. The third part then describes the operative and technical considerations in crown and bridge prosthodontics.

The authors are of the opinion that complete mouth rehabilitation is accomplished best by the use of full coverage restorations. Therefore, more attention is given to the construction of the full cast gold crown, the cast gold acrylic veneer crown, and the porcelain jacket crown, although cast gold onlays are included. Other procedures presented are: copper plating technique, construction of splints, centric registration, acrylic resin processing, soldering, and construction of movable-removable precision attachments. Steps in preparation and construction generally are well illustrated and outlined.

It is unlikely that there will be widespread use of the book by undergraduate students except, and the authors so state, as a means of becoming acquainted with the *possibilities* of complete mouth rehabilitation. The general practitioner will find the book a valuable *guide* in the diagnosis, planning, and treatment for such rehabilitation. But generally the volume will be most useful to that relatively small group of quasi-specialists who are including in their practices this rather involved phase of dental therapy.

T. F. McBride

Special Announcement

NOW AVAILABLE

Reprints of THE GLOSSARY OF PROSTHODONTIC TERMS, bound in heavy paper covers.

THE GLOSSARY OF PROSTHODONTIC TERMS by The Academy of Denture Prosthetics, as edited by The Nomenclature Committee of the Academy: Carl O. Boucher, D.D.S., Chairman; Richard H. Kingery, D.D.S., LeRoy E. Kurth, D.D.S., Victor H. Sears, D.D.S., Vincent R. Trapozzano, D.D.S., and Jack Werner, D.D.S., was published in the JOURNAL OF PROSTHETIC DENTISTRY, Vol. 6, No. 2 (March), 1956. It is the result of three years' effort on the part of the Nomenclature Committee and members of The Academy of Denture Prosthetics. The Glossary consists of 34 pages and contains over 800 terms and definitions. It represents the most modern concepts of the terms used in prosthodontic literature by the majority of the members of the Academy of Denture Prosthetics. It is a useful and valuable reference.

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FIFTH ANNUAL ESSAY CONTEST

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PRIZES WILL BE AWARDED to the two senior dental students who submit the best essays on prosthetic dentistry in the fifth annual essay contest sponsored by The American Denture Society. The purpose of the contest is to stimulate technical writing by dental students.

The first prize is Five Hundred Dollars ($500.00) and the second prize is Three Hundred Dollars ($300.00).

RULES

1. The contest is open to all senior dental students in the dental colleges of the United States and Canada.
2. Only two essays may be submitted from any one dental college. (It is recommended that each dental college conduct its own contest to determine the two best essays submitted by members of its senior class.)
3. All essays submitted in the contest shall be accompanied by a letter from the professor of prosthetic dentistry and/or the dean of the dental college from which they originate. This provision is to assure the authenticity of all essays entered in the contest.
4. Essays must be postmarked on or before July 15, 1957. It is recommended that students start preparing their essays by the middle of their junior year and complete them by the middle of their senior year.
5. Essays are to be on some phase of prosthetic dentistry, and limited to a maximum of 2,500 words.
6. Essays must be worthy of publication in the JOURNAL OF PROSTHETIC DENTISTRY.
7. Essays must be typewritten, double spaced, on a good grade of white bond paper 8½ by 11 inches. No carbon copies or essays on onion skin paper will be considered. Paragraphs must be indicated clearly by indentations, and generous margins must be allowed on each page.
8. Illustrations must conform to the standards of the JOURNAL OF PROSTHETIC DENTISTRY, if they are used. Only good glossy black and white photographic prints or drawings in India ink may be used. Each illustration should be mounted on a separate sheet of paper with the figure number and the legend typed on the paper beneath the illustration.

9. References must conform to the style used in the JOURNAL OF PROSTHETIC DENTISTRY.

10. Essays are to become the property of The American Denture Society. None will be returned.

11. The judges of the contest are members of a committee of The American Denture Society. The decision of the judges is final.

12. Essays are to be clearly marked "Contest Essay" and sent, with a letter from the professor of prosthetic dentistry or the dean of the dental college indicating that this essay is an official entry from the dental college, to:

Dr. Victor L. Steffel

Secretary, American Denture Society
College of Dentistry, Ohio State University,
Columbus 10, Ohio

News and Notes

MEETINGS

American Denture Society, Congress Hotel, Chicago, Ill., Feb. 2 and 3, 1957.

American Academy of Restorative Dentistry, Conrad Hilton Hotel, Chicago, Ill., Feb. 2 and 3, 1957.

American Academy of Crown and Bridge Prosthodontics, Conrad Hilton Hotel, Chicago, Ill., Feb. 2 and 3, 1957.

Dallas Midwinter Dental Clinic, Statler Hilton Hotel, Dallas, Tex., Jan. 27 to 30, 1957.

Academy of Denture Prosthetics, Deshler-Hilton Hotel, Columbus, Ohio, April 28 to May 4, 1957.

American Association for Cleft Palate Rehabilitation, Hotel Cleveland, Cleveland, Ohio, May 2 to 4, 1957.

For further information, write to McKenzie W. Buck, Speech and Hearing Clinic, University of Florida, Gainesville, Fla.

Tenth Triennial Pacific Coast Dental Conference, San Diego, Calif., Aug. 19 to 22, 1957.

Inquiries and requests for reservations may be addressed to Dr. C. W. Gilman, Secretary, 219 East 8th St., National City, Calif.

DENTURE RELINERS SOLD TO THE PUBLIC

One of the current investigations in the cooperative dental research between the National Bureau of Standards and the American Dental Association deals with denture relining materials sold directly to the public. The composition, mechanism of hardening, physical properties, and effect on the denture base materials are being determined.

Dentures on which the reliners have been used are needed. If any reader of THE JOURNAL OF PROSTHETIC DENTISTRY has a denture or dentures on which any of the reliners were used by the patient, please send them to the *American Dental Association Research Division, National Bureau of Standards, Washington 25, D. C.* Any information pertaining to the patient's experience with the reliner would be most helpful. If at all possible, obtain the name of the reliner used by the patient and supply the following information:

Was the patient's mucosa burned or injured in any way by the relining material?

Was the relationship between the denture and the opposing teeth changed by relining the denture by the patient?

Was the patient pleased with the results obtained when he or she attempted the relining?

This activity deserves your cooperation.—Ed.

ANNOUNCEMENTS

New York University, College of Dentistry, announces a refresher course in Periodontia and Oral Medicine Feb. 20-May 1, 1957, on Wednesdays. For further information, write to the secretary, Postgraduate Division, New York University, College of Dentistry, 209 East 23rd St., New York 10, N.Y.

The University of Alabama, School of Dentistry, announces the following refresher courses:

Diagnosis and Treatment of Occlusal Deformities, Dr. Louis Alexander Cohn, Feb. 16-18, 1957.

Removable Orthodontic Appliance Construction, Dr. Samuel D. Gore, Feb. 23-25, 1957.

Insurance, Investment, and Estate Planning, March 2 and 3, 1957.

Income Tax Guidance, March 14, 1957.

Periodontology, Dr. William McIntosh, March 23 to 25, 1957.

For further information write to Refresher Course Program, University of Alabama, School of Dentistry, 1919—7th Ave. S., Birmingham 3, Ala.

The School of Dentistry, University of Pennsylvania, announces the following postgraduate courses:

Minor Tooth Movement and Temporary Stabilization, Leonard Hirschfeld, Jan. 21-23, 1957.

Crown and Bridge Prosthesis, Charles B. Sceia, Jan. 28-Feb. 1, 1957.

Hydrocolloid Indirect Technique for Inlays and Bridges, Morris J. Thompson, Feb. 16-17, and Feb. 17-18, 1957.

Partial Dentures, M. M. DeVan, Feb. 11-16, 1957.

For further information concerning these courses please communicate with Postgraduate Courses, University of Pennsylvania, School of Dentistry, 4001 Spruce St., Philadelphia 4, Pa.

The Medical College of Virginia, School of Dentistry, announces a series of postgraduate courses of interest to general practitioners. These courses are given by the members of the faculty, unless otherwise designated.

Partial Denture Design, Vincent R. Trapozzano, Jan. 21 to 26, 1957.

Crown and Bridge Prosthesis, Feb. 18 to 20, 1957.

Oral Diagnosis, March 11 to 15, 1957.

Anatomy of the Head and Neck, March 18 to 22, 1957.

Oral Surgery, April 1 to 3, 1957.

Roentgenology, April 8 to 10, 1957.

For further information, write to H. T. Knighton, Director of Postgraduate and Graduate Instruction, Medical College of Virginia, School of Dentistry, Richmond 19, Va.

Temple University School of Dentistry announces the following postgraduate courses for the 1956-1957 session:

Advanced Orthodontics, Dr. Robert H. W. Strang, Jan. 20-Feb. 2, 1957.

Practice Administration, Dr. Jay H. Eshleman, Jan. 30-Feb. 1, 1957.

Periodontal Prosthesis, Dr. Morton Amsterdam and Dr. Walter Cohen, Feb. 11-16, 1957.

Periodontics, Dr. Jacoby Rothner and Staff, March 4-16, 1957.

Orthodontics in Periodontal Therapy, Dr. Jack Alloy and Dr. Maxwell Fogelman, April 11-13, 1957.

For additional information and application, write to Dr. Louis Herman, Postgraduate Division, Temple University School of Dentistry, 3223 North Broad St., Philadelphia 40, Pa.

The Ohio State University College of Dentistry announces a series of postgraduate courses to be presented during the 1956-1957 school year. The enrollment of each course is limited in order to permit intimate teaching.

Complete Denture Prosthodontics, Dr. Carl O. Boucher, Feb. 25 to March 1.

Endodontics, Dr. J. Henry Kaiser, Jan. 21 to 25.

Oral Diagnosis, Dr. Hamilton B. G. Robinson, Jan. 28 to Feb. 1.

Crown and Bridge, Dr. Frank C. Starr, Feb. 11 to 15.

Partial Denture Prosthodontics, Dr. Victor L. Steffel, Feb. 18 to 22.

General Anesthesia, Dr. Morgan L. Allison, March 4 to 8.

Anatomy of the Head and Neck, Dr. Linden F. Edwards, March 18 to 22.

Oral Surgery, Dr. Morgan L. Allison and Staff, April 8 to 12.

Pedodontics, Drs. Lyle S. Pettit and B. H. Williams, May 6 to 10.

Review of Clinical Dentistry, Dental Faculty, May 13 to 17.

For further information and application, write to Postgraduate Division, College of Dentistry, Ohio State University, Columbus 10, Ohio.

The Beth Israel Hospital announces a two-week seminar in Periodontia to be given March 11-22, 1957. The course is under the direction of Henry M. Goldman, D.M.D., and Bernard Chaikin, D.M.D. For further information write to Director of Public Relations and Education, Beth Israel Hospital, 330 Brookline Ave., Boston 15, Mass.

The Veterans Administration Hospital, Iowa City, Iowa, in affiliation with the State University of Iowa, College of Dentistry, announces that two rotating dental internships and one residency in Prosthetics will be available for the year beginning July, 1957. Application material and information may be obtained from the Chief, Dental Service, VA Hospital, Iowa City, Iowa.

The Ohio State University College of Dentistry announces that it is receiving applications of students for the Curriculum of Dental Laboratory Technology. This course of study of the laboratory phases of prosthodontics extends over two academic years and leads to a Certificate of Graduate Dental Laboratory Technologist. For further information, write to the Chairman of Dental Laboratory Technology, Ohio State University College of Dentistry, Columbus 10, Ohio.

Readers' Round Table

WASHINGTON, D.C.

EDITOR, THE JOURNAL OF PROSTHETIC DENTISTRY:

In answer to Dr. M. M. House's "A Challenge" [J. PROS. DEN. 2:434-437, 1952], and to Dr. John W. Geller's "Will Dentistry Accept The Challenge?" [J. PROS. DEN. 6:435-440, 1956], I made inquiries in the possibility of making Washington, D. C., the repository for the dental museum under discussion.

I contacted Miss Helen Purtle, the Assistant to the Curator of the Medical Museum of the Armed Forces Institute of Pathology. She feels that this museum would be the most logical and most useful depository for our dental museum.

According to the policy of the Armed Forces Institute of Pathology the material placed into their possession would be as close to researchers as a three-cent stamp. A request for material would be shipped to any part of the United States.

There would be no need to raise large amounts of money because the cost of housing and maintenance of museum material is paid for by the U. S. Government. The only cost that might be required from private sources might be that of printing a catalogue from time to time to list the study material on hand in the museum.

Enclosed with this letter is a reply to my inquiry from Colonel Francis E. Council, the Director of the Medical Museum of the Armed Forces Institute of Pathology. I feel that his letter should also be published in conjunction with this letter in the Readers' Round Table.

If there should be any other information desired by any individual or groups, I will be glad to make further inquiries, or they could write direct to Colonel Council.

With the hope that some definite action is taken by organized dentistry, I am,

Sincerely yours,

MEYER M. SILVERMAN, D.D.S.

Dear Doctor Silverman:

The Medical Museum of the Armed Forces Institute of Pathology has a long established policy of accepting valuable collections of medico-historic material to be used for display and to be made available for research.

The Museum would be glad to be designated the repository for the collections of historic dental prosthesis, and would be happy to cooperate with you in collecting and preserving this material, and in making same available for scientific research.

Sincerely yours,

FRANCIS E. COUNCIL
Colonel, MC, USA,
Deputy Director